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INSTRUCTION MANUAL

MODEL 1901C
DISPLAY
OSCILLOSCOPE

SEL

WAVETEK® INDIANA, INC.
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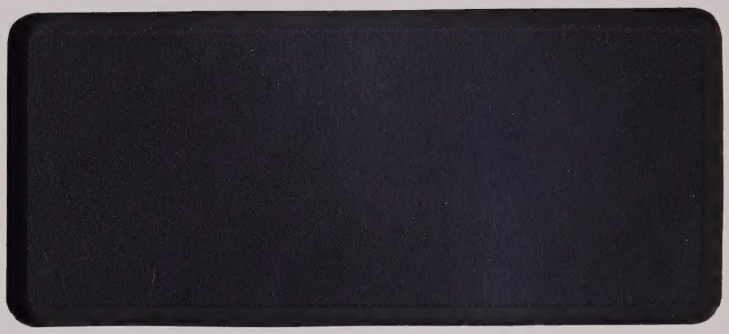

Serial No. _____

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Wavetek Display Oscilloscope is a low cost, large screen, solid state, X-Y display oscilloscope designed for production and laboratory test systems which employ sweep generator techniques.

For these applications several features have been incorporated in this large easy to read display.

1. Y-axis marker adder circuit.
2. Vertical polarity reversal.
3. Automatic spot blanking to prevent burning of the CRT phosphor.
4. Molded graticule for minimum paralax.

This instrument can also be used in many general purpose applications where a large screen X-Y display oscilloscope is required. Features important in the display for these applications are:

1. High frequency Z-axis amplifier for pulse marker or grey scale use.
2. Excellent full scan linearity.
3. High vertical sensitivity, up to 1 mV/division.
4. Ultra stable, low noise display.

The most outstanding features of this large-screen unit are its strength and reliability.

In the event servicing is required, maintenance personnel will find that the unit's p.c. board construction with convenient component layout plus a comprehensive instruction manual contribute to making this instrument easy to service.

1.2 SPECIFICATIONS

1.2.1 DISPLAY

CRT	12" diagonal (30 cm)
PHOSPHOR	P1 Medium persistence - Green
GRATICULE	12 vertical - 16 horizontal divisions (1.5 cm/div)
DEFLECTION	Magnetic
ACCELERATOR VOLTAGE	9kV nominal

1.2.2 VERTICAL

SENSITIVITY	4 position step attenuator for 1mV/div., 10 mV/div., 100mV/div., and 1V / div. Continuously variable vernier between steps.
INPUT IMPEDANCE	374K ohm
BANDWIDTH	DC to 15kHz (10 div. amplitude)
LINEARITY	5% (center 10 div.)
COUPLING	Switchable AC-DC (when AC coupled max DC voltage plus AC peak not to exceed 200V).
INPUT CONNECTOR	BNC, front panel
DRIFT	Less than ½ div/8 hr. (at a constant ambient after ½ hour warm up).

	POLARITY REVERSE	Vertical signal can be inverted with front panel switch.
1.2.3	MARKER ADDER	
	INPUT SIGNAL	Pulse or birdy
	SENSITIVITY (Max)	0.5 V/Division - continuously adjustable with rear panel control
	POLARITY	Rear panel polarity reversal switch
	INPUT IMPEDANCE	Approximately 15K ohm
1.2.4	HORIZONTAL	
	SENSITIVITY	Continuously adjustable from less than .1V Division to over 10V/Division.
	INPUT IMPEDANCE	Greater than 320K ohm
	BANDWIDTH	DC to 1.5KHz (14 div. amplitude)
	LINEARITY	3% (16 div.)
	COUPLING	Switchable AC-DC (when AC coupled max. DC voltage plus AC peak not to exceed 200V).
	INPUT CONNECTOR	BNC, front panel
	DRIFT	Less than ½ div/8 hr. (at a constant ambient temperature after ½ hour warm up)
1.2.5	INTENSITY MODULATION	
	SENSITIVITY	Adjustable from less than 1 V peak-to-peak to more than 10 V peak-to-peak for full modulation.
	INPUT IMPEDANCE	20 kΩ in parallel with 10 pF
	INPUT CONNECTOR	BNC, rear panel
	BANDWIDTH	Flat from DC to 1 MHz, 3 dB down at 3.5 MHz, 10 dB down at 10 MHz.
	POLARITY	Positive going voltage intensifies the trace. Internally changable for Positive Blanking
1.2.6	PROTECTION CIRCUIT	Prevents burning of the CRT by blanking the beam when the horizontal signal is less than approximately 4 divisions (60 Hz rate). When operating at a slower rate, or for servicing, a rear panel switch can be used to eliminate the protection circuit. May be changed internally to operate with vertical signal.
1.2.7	POWER	115/230 VAC ±10% 50/60 Hz (approximately 75 watts)
1.2.8	OPERATING TEMPERATURE	+10° to +50°C
1.2.9	MECHANICAL	
	DIMENSIONS	10 5/16" (262 mm) high x 14½" (368 mm) long x 16½" (419 mm) wide
	WEIGHT	26 pounds (11.8 Kg)

1.3 OPTIONS

OPT A	P4 phosphor, medium short persistence - white
OPT B	P7 phosphor, long persistence - blue
OPT C	clear face plate (no graticule)
OPT D	amber filter. Mounts between tube and face plate. (normally used with P7 phosphor.)

1.4 ACCESSORIES

INCLUDED	Operating Instruction Manual
AVAILABLE	Rack Mounting Kit
	Spare face plate without graticule
	Spare face plate with graticule

SECTION 2
INSTALLATION

2.1 INTRODUCTION

This section contains information for receiving and preparing the Display for use.

2.2 MECHANICAL INSTALLATION

2.2.1 INSPECTION AND DAMAGE CLAIMS

After unpacking, the instrument should be inspected for physical damage. A procedure for checking the electrical performance is given in Section 5. The shipping container and the packing material should be saved in case it becomes necessary to reship the unit.

If the unit is damaged or does not meet the electrical performance checks, notify the nearest Wavetek representative or the factory in Indiana. If the shipping container shows damage, notify the carrier. Retain the shipping container and packing material for the carrier's inspection. In either case, the factory or area representative will arrange for immediate repair or replacement of your instrument, without waiting for damage claim settlements.

2.2.2 OPERATING LOCATION

This unit can be used either on a bench or in an instrument rack. In either case insure that air flow is not restricted from passing through the rear panel heat sinks or ventillating holes.

Rack - Mounting kit, K107, enables the Display scope to be mounted in a standard 19" wide instrument rack. The kit consists of two aluminum brackets which fasten to the sides of the unit as shown in figure 2-1. Necessary screws are located in the pre-drilled holes provided for this accessory.

2.3 ELECTRICAL INSTALLATION

2.3.1 CONNECTION TO AC LINE

Before plugging in the instrument check the rear panel AC line voltage switch and the fuse to insure that the unit is prepared to operate with the available voltage. Fuse for 115V operation should be 2 A, for 230 V, 1 A.

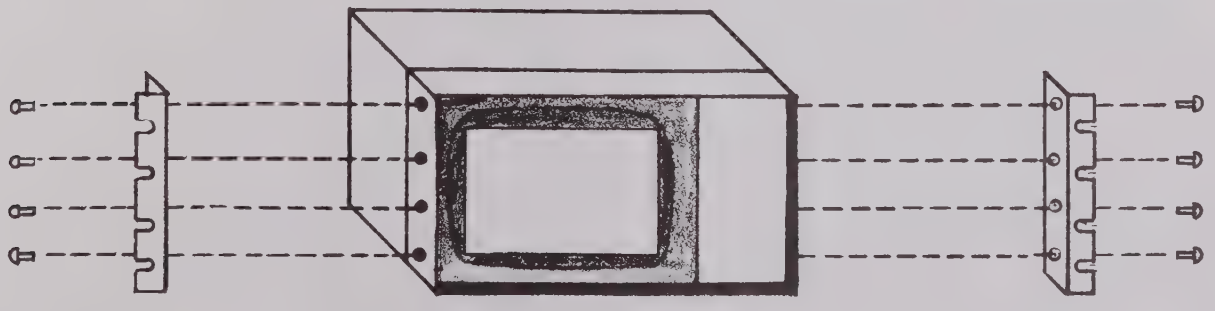


Figure 2-1. Rack Mounting Kit

2.3.2 PERFORMANCE

When the unit is turned on it is ready to use without warmup. For an electrical performance check of instrument refer to Section 5.3 of this manual.

2.3.3 Preliminary Operating Setup

There are three features of operation which are internally selectable by the customer.

1. Auto blanking axis (normally horizontal)
2. Auto blanking defeatability
3. Z-axis polarity (normally negative blanking)

To determine which operation is desired refer to description of rear panel controls, INTENSITY and AUTO BLANK, in Section 3.

AUTO BLANKING

A dual slide switch is located in the center of the main p.c. board. One half is for selecting either the horizontal or vertical signal to operate the Auto Blanking circuit. The other half is for defeating the operation of the rear-panel AUTO BLANK switch. The instructions for selecting the desired positions are in the upper left corner of the p.c. board. See Figure 5-5. In the ON position blanking will occur automatically and the rear-panel switch has no effect. In the OFF position the rear-panel AUTO BLANK switch can operate to allow or defeat automatic blanking. (Rear panel switch is normally ON.)

Z-Axis

To switch the polarity of the intensity modulation amplifier reverse the leads on the right side of the main p.c. board as shown in Figure 5-5.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section includes descriptions of front and rear panel controls.

This instrument is ideal for use in conjuction with a Wavetek sweep generator. The vertical and horizontal amplifier specifications are very compatible with the signals that generate a demodulated RF response. The Y and Z marker inputs can be used conveniently with the various marker signals from the sweep generator. Consult the sweep generator manual for specific hookup instructions.

Applications for this instrument are certainly not limited to use with sweep generators. Any instrumentation requiring a large screen, X-Y display scope can include this unit.

3.2 DESCRIPTION OF FRONT PANEL

INTENSITY

Controls the brightness of the display.

POWER

Toggle switch applies primary power to the instrument. The LED Pilot light indicates an operating condition.

VERTICAL

POSITION..controls the vertical position of the trace. Pull to invert display.

GAIN...V/Div selects the vertical amplifier deflection factor. The vernier control provides a continuously variable adjustment between the ranges of the V/Div switch (Vernier must be fully clockwise to indicate a calibrated deflection factor). Input coupling of the vertical signal is normally DC. Pulling out on the vernier control will provide AC coupling of the input signal.

INPUT V...BNC connector for the vertical input signal. Maximum peak input should not exceed 200 V.

HORIZONTAL

POSITION...controls the horizontal position of the trace.

GAIN...vernier control provides a continuously variable adjustment of the horizontal input signal. Input coupling of the horizontal signal is normally DC. Pulling out on the vernier control will provide AC coupling of the input signal.

INPUT H..BNC connector for the horizontal input signal. Maximum peak input should not exceed 200 V.

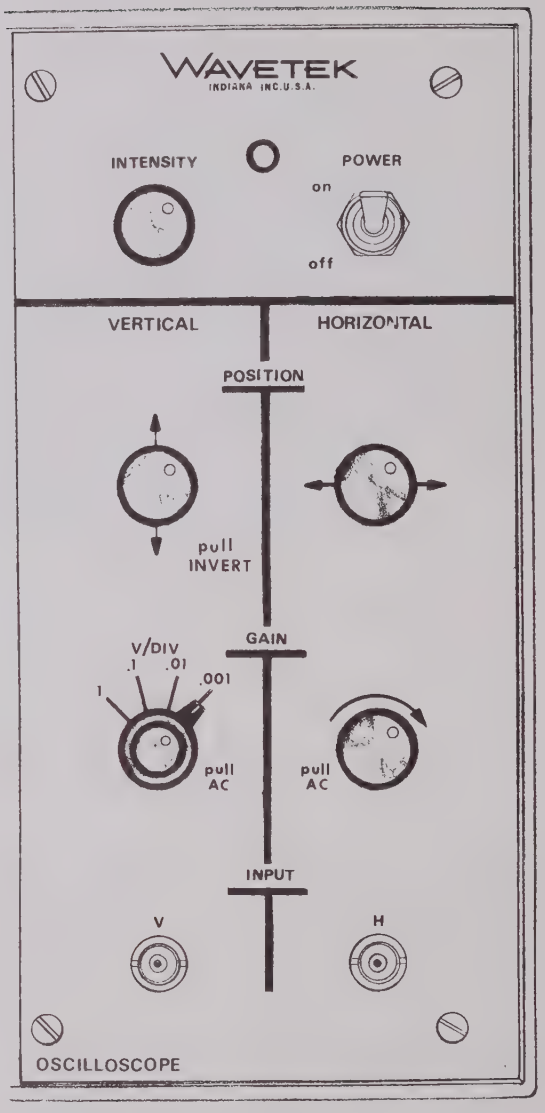


Figure 3-1. Front Panel

3.3 DESCRIPTION OF REAR PANEL

VERT MARKER

INPUT...BNC connector for applying pulse or birdy type markers to displayed signal. (100 V maximum input.)

SIZE...provides continuous adjustment of the marker size. Maximum sensitivity (fully clockwise) is 0.5 volts per division.

POLARITY...provides inversion of displayed pulse markers.

INTENSITY

INPUT...BNC connector for applying intensity modulation signals to display. A positive input intensifies and a negative input blanks the displayed signal. An internal wiring change can reverse the polarity of this Z axis amplifier. See Section 2.3.3.

CONTRAST...controls the difference in brightness between the X-Y display and the Z axis signal.

AUTO BLANK

In the ON position, the Auto Blanking circuit blanks the CRT beam in the absence of a horizontal signal in order to prevent burning of the CRT phosphor. In the OFF position, the blanking circuit is disabled to allow operation at slow sweep rates or to aid in servicing. Caution must be observed in the OFF position to prevent burning of the CRT phosphor.

Two internal switches are provided in this circuit. One disables the OFF position of the rear panel switch; the other switches the actuating signal from horizontal to vertical. For instructions see Section 2.3.3.

AC LINE

INPUT... three prong plug provides connection to AC mains.

VOLTAGE...Switch selects 115 or 230 VAC line voltage.

FUSE...3 AG type, Slo-Blo, 2 amp for 115 VAC or 1 amp for 230 VAC.

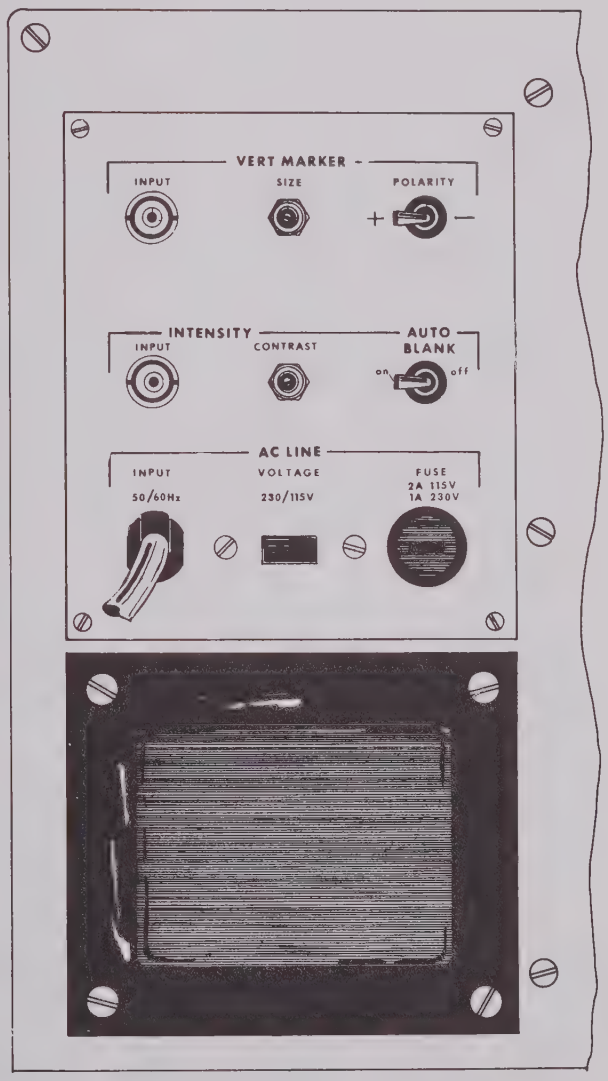


Figure 3-2. Rear Panel

SECTION 4
THEORY OF OPERATION

4.1 INTRODUCTION

This section first presents an overall block diagram analysis followed by a more detailed description of each block.

Figure 5-6 is a top view of the Display with the main sections labeled. This will serve as a physical reference corresponding to the circuit descriptions.

4.2 SIMPLIFIED BLOCK DIAGRAM

The block diagram of Figure 4-1 shows the relationship of each main section to the total operation of the unit. The CRT (Cathode Ray Tube) is the heart of the display. The composite signal of all the inputs to the unit is displayed on the face of the CRT.

The Power Supply provides the unit with five voltage sources. The +68 and ±15.5 volt supplies are regulated. The ±32 volt supplies are unregulated.

The High Voltage supply provides +9kV to the anode of the CRT. The power source for this section is the +32 volt supply. The High Voltage supply also provides positive voltages for G2 and G4 (the focusing electrode), of the CRT.

The Vertical Amplifiers convert the input voltage signal into a current signal for the Vertical-deflection Yoke. The pre-amp includes the front panel controls for adjusting the amplifier gain both in steps and continuously. Before the final stage of the vertical amplifier, the vertical marker signals are added to the main signal.

The Horizontal Amplifier converts the input voltage signal to a corresponding current signal for the Horizontal Yoke on the CRT. The Horizontal Amplifier has front panel controls for adjusting the GAIN and POSITION of the horizontal display on the CRT.

The Intensity Modulation circuit provides for front panel control of the brightness of the display. In addition, an external modulating signal can be amplified and applied to the CRT to produce markers or varying shades.

The Auto Blanking circuit prevents the CRT from burning when the beam is not being deflected with an alternating signal from either the Horizontal or Vertical Amp.

4.3 POWER SUPPLY

The outputs are +68 and ±15.5V regulated DC, as well as ±32V unregulated DC.

A dual primary transformer, T301, allows for a line voltage of either 115V or 230V AC. The 50V secondary is center tapped to allow for two full-wave rectified voltages. Unregulated +32 and -32 are filtered by C301 and C302 respectively. The +15.5 and -15.5 supplies are powered by the ±32 volt supplies. They are zener-diode regulated and have pass transistors for higher output current capability.

The source of the +68 supply is approximately +96 volts derived from a voltage doubler stacked on top of the +32V supply. The +68 volts is regulated by a zener diode (CR38).

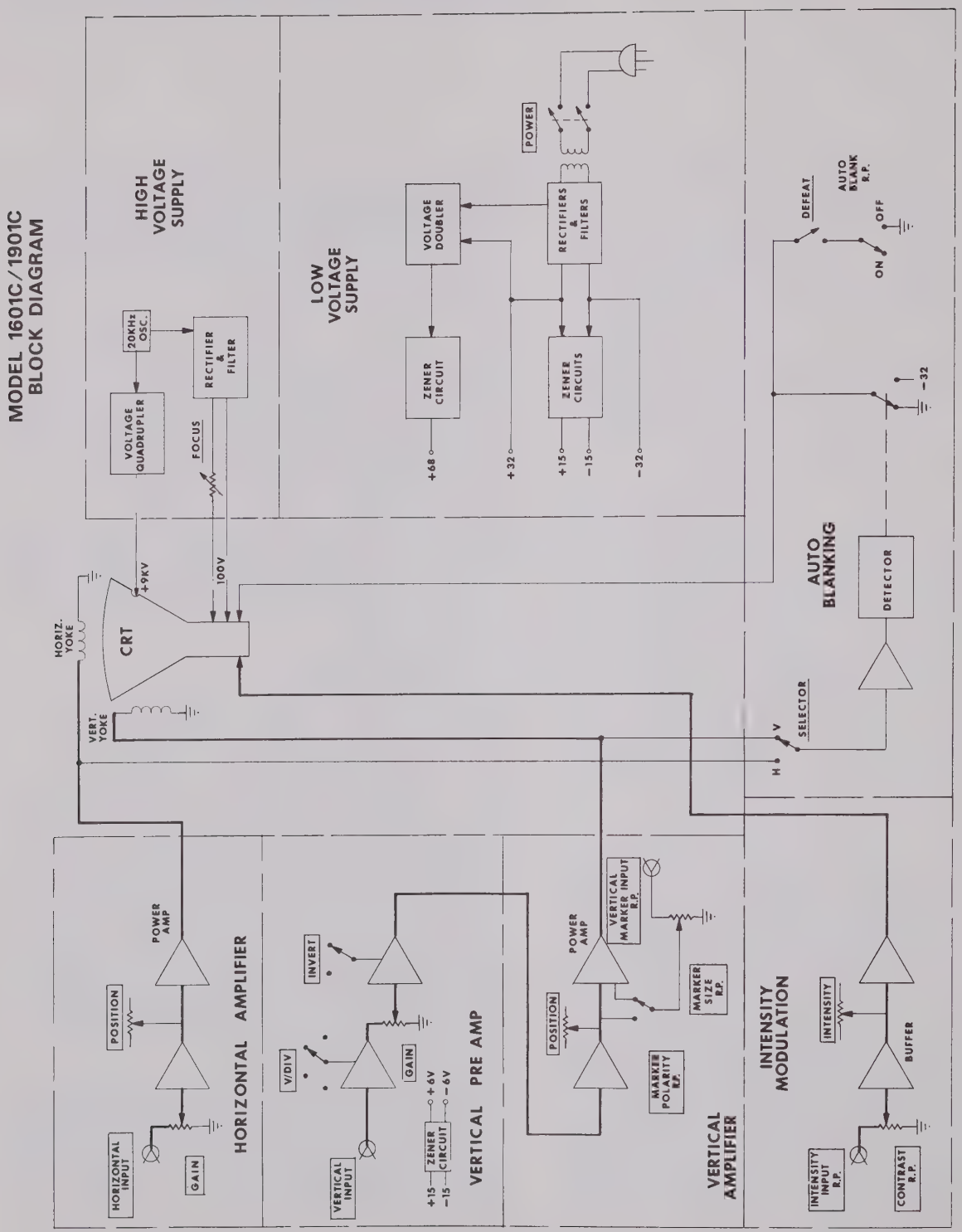


Figure 4-1. Display Block Diagram

4.4 HIGH VOLTAGE SUPPLY

The high voltage circuit is located away from the main printed-circuit board (See Figure 5-6) and housed in a steel enclosure to prevent 20 kHz radiation.

The high voltage circuit contains Q201, Q202, and Q203. It provides 9kV to the CRT anode as well as voltage for the focusing electrode (G4) and +100V for G2. Q203 is the heart of a ringing choke oscillator that develops a 20 kHz signal across T201. This voltage is coupled to the two different high voltage circuits. The oscillator signal is stepped up from 17 Vp to 2.25 kVp in the secondary connected to C208. It is then increased to +9kV DC by the cascade quadrupler. The oscillator signal is stepped up to 355Vp in the other secondary and rectified by CR202 and C207. The 355 volts is then fed to the focus control, R105, located on the Main Board. The 100 volt supply is derived from a voltage divider on the 355 volt output.

Q201 and Q202 provide the supply voltage to the oscillator. This voltage is controlled by a feedback signal in order to maintain a constant output level from the oscillator. The feedback is taken from R102 which is also the High Voltage adjustment. As the 9kV supply is loaded, a bigger load is seen by the oscillator. This temporarily lowers the oscillator supply voltage, consequently coupling less voltage to the 355V circuit. This results in a lower voltage at R102. This is inverted and amplified to provide a larger voltage supply to the oscillator, thus correcting for the additional loading.

4.5 VERTICAL AMPLIFIER

The Vertical Amplifier consists of two sections, the pre-amplifier and the power amplifier.

The Vertical pre-amplifier is mounted on a separate board and installed on the FRONT PANEL directly behind the vertical input jack. The power for this stage is ±6V. These voltages are derived from two zener-diode regulators connected to the +15.5 volts and -15.5 volts.

The vertical input impedance is 374 kΩ determined by R612. The signal first goes through one half of Q601, a dual FET. The vertical DC balance is adjusted at the gate of the other half. Q601 acts as a current offset compensation device for IC601. IC601 is an op. amp. with a gain which is determined by switched feedback resistors R601 through R604. S602 is the GAIN switch on the front panel which can select a sensitivity of 1, .1, .01 or .001 volts/division. The front panel vertical GAIN control, R615, adjusts the input amplitude to the next stage, IC602A.

IC602B is normally a non-inverting amplifier with a gain of about one. When pin 5 is grounded by the PULL INVERT switch, S403, this stage becomes an inverting amplifier with a gain of one. Thus the scope display will be inverted. The output of this stage then goes to the Power Amplifier.

The input to this stage is applied to R4 which is an internal pot for calibrating the vertical gain. The Vertical power amplifier consists of IC1, Q1 through Q6, Q301 and Q302. The inputs to this stage are the vertical preamplifier output and the "Y" marker input signals. These "Y" markers can be either pulse or birdy type markers. IC1A is a fixed-gain inverting op. amp; the input to which comes from the preamp. The output of IC1A is applied to the input to IC1B at which point are added the "Y" markers and the POSITION control voltage. IC1B is an inverting op. amp. Its feedback signal is the voltage across R30 which is proportional to the current signal through the vertical yoke. Q1, 2, 5, 6, 301 and 302 is a complementary symmetry, push-pull amplifier which provides high current gain for the vertical signal. Q3 and Q4 provide current limiting for Q301 and Q302. This prevents damage to the power transistors when the incoming signal is adequate to deflect the display off the face of the CRT.

The vertical yoke (L301A) provides the magnetic field which deflects the electron beam in the CRT up or down corresponding to changes in the voltage signal at the vertical input.

4.6 HORIZONTAL AMPLIFIER

The Horizontal Amplifier consists of IC2 and Q9 through Q14. The input is fed directly into the Horizontal GAIN pot, R402. A selected fraction of the input signal is then sent to one half of IC2. This op. amp. acts as a buffer for the horizontal input signal. The output of this goes to the other half of IC2. The other inputs at this point are the horizontal position signal from R403 and the feedback signal voltage from R64.

The circuit consisting of R47, R48, CR21, 22, 23 and 24 is designed to improve the display linearity during the furthest excursion of the signal.

The signal is then sent to a complementary symmetry, push-pull stage consisting of Q9, 10, 13, and 14. This provides the high current gain necessary for driving the yoke. Q11 and Q12 are current limiters which prevent damage to Q13 and Q14 when the incoming signal is adequate to deflect the display off the face of the CRT. The horizontal section of L301 provides the magnetic field for the horizontal deflection of the electron beam.

4.7 INTENSITY MODULATION

This two stage amplifier drives the cathode of the CRT. The first stage (Q22, 23 and 24) is a high impedance buffer for the intensity modulation input signal. The CONTRAST control varies the input level to this stage.

The second stage including Q17, 25 and 26 combines and amplifies the signals from the first stage and the front-panel INTENSITY control. The modulating signal from stage one can be applied to either the inverting or non-inverting input of stage two as shown on schematic.

4.8 AUTO BLANKING

This circuit consists of IC3 and Q19. The input to IC3 is an alternating signal from either the horizontal or vertical amplifier depending on setting of S1A. This AC signal is amplified in IC3 and an average negative value is detected by CR29 and C11. Q19 is biased on by this signal. When the horizontal deflection is less than approximately 2 scope divisions, the voltage on C11 is not sufficient to keep Q19 turned on. Turning Q19 off allows "G1" of the CRT to be biased with the -32 volt supply through R94 and CR42. This voltage will prevent electron flow to the CRT face thus preventing damage to the phosphor when there is no AC deflection signal. This circuit can be overriden with S502 and S1B allowing extremely slow sweep rates to be displayed.

4.9 CATHODE RAY TUBE (CRT)

It uses magnetic deflection and includes the following specifications: P1 phosphor (P4 or P7 phosphors are optional), electrostatic focusing (G4), 90° diagonal deflection, and 12.6V heater voltage. The face is raised to +9kV by the High Voltage circuit.

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides information for performance testing, calibrating, and troubleshooting the Wavetek Display. The performance test is designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to calibration and troubleshooting, Sections 5.4 and 5.5.

5.2 SERVICE INFORMATION

5.2.1 DISASSEMBLY

Most servicing can be done by simply removing the dust cover. Servicing the vertical pre-amp assembly can be facilitated by removing the front panel from the chassis. The high voltage circuit must be removed from can for servicing. Refer to Figure 5-6 for locations of assemblies.

DUST COVER REMOVAL

To remove the dust cover, remove the three screws on each side of the unit (Figure 5-1). Move cover back and up.

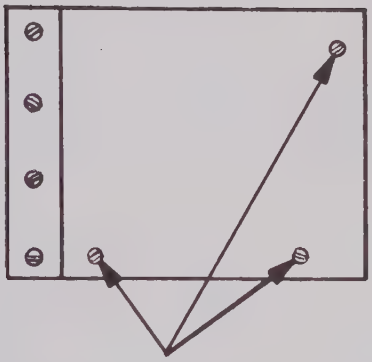


Figure 5-1. Display Side View

HIGH VOLTAGE ASSEMBLY REMOVAL

WARNING

There is an operating potential of +9000 volts on high-voltage connector.

First, turn unit off and remove dust cover. Slide a grounded screw driver under high-voltage connector cover. When voltage is discharged, remove connector from CRT by pushing connector sideways until one side of spring clip is released from receptacle on CRT then pulling other side of spring clip out. Next, disconnect 6-pin harness connector from main p.c. board. Finally, remove two screws from bottom of chassis which hold high-voltage box in place. To remove the high-voltage circuit from its metal box, remove horizontal screw from each side of lid. DO NOT remove screws or nuts on top of lid. The circuitry is mounted on the lid and will be removed from the box when the lid is lifted straight up.

FRONT PANEL REMOVAL

Turn unit off and remove dust cover. First, disconnect 15-pin connector from main p.c. board. Next, remove nut holding POWER switch to front panel. Finally, remove four screws in corners of panel and pull assembly forward and slightly to the right.

5.2.2 REASSEMBLY

Instrument can be reassembled by reversing the appropriate instructions in Section 5.2.1. When reinstalling a harness connector on a printed-circuit board, be sure connector is properly aligned with the board connector pins and that connector faces proper direction (See Figure 5-2).

CAUTION

Failure to properly orientate the connector can result in damage to circuitry.

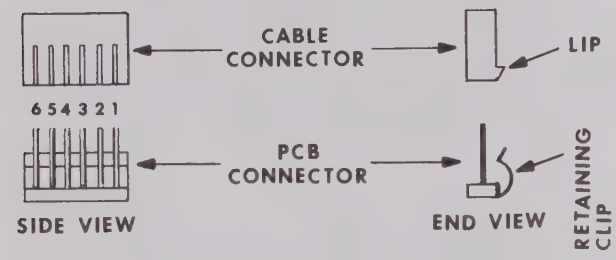


Figure 5-2. Connector Alignment

5.3 PERFORMANCE TESTS

The following procedure is intended to insure that the instrument meets its published specifications. Needed to perform the following tests are a Wavetek Model 144 function generator (or two independent signal sources) and a general-purpose lab-grade oscilloscope. See Table 5-1. Refer to Sections 3.2 and 3.3 for locations and descriptions of controls on Wavetek Display unit.

The Auto-Blanking circuit in most units is fed by the horizontal amplifier; therefore, the performance test procedures are based on this assumption. If the unit being tested is set for vertical auto-blanking, switch to horizontal before proceeding. Instructions for switching are in the upper-left corner of the main p.c. board. Before turning unit on, switch rear panel AUTO BLANK switch to the on position. Switch POWER on and allow a five minute warm up before proceeding.

TABLE 5-1. RECOMMENDED TEST EQUIPMENT FOR PERFORMANCE TESTS AND CALIBRATION

INSTRUMENT	CRITICAL REQUIREMENTS	RECOMMENDED
Oscilloscope	Lab Grade, D.C. coupled 10 MHz bandwidth	Tektronix 5403 main frame 5A48 Vertical Amp 5B42 Time Base
Voltmeter	10 Megohm input impedance	Weston Model 4440
Function Generator	2 independent frequency outputs	Wavetek Model 144
HV Probe	300 Megohm input impedance	Pomona Model 3157 High voltage test probe

5.3.1 VERTICAL POSITION CONTROL CHECK

1. Set Display controls as follows:

INTENSITY	minimum (fully ccw)
HORIZONTAL POSITION	mid range
VERTICAL POSITION	mid range
HORIZONTAL GAIN	mid range
VERTICAL GAIN (switch)	1V/div
VERTICAL GAIN (vernier)	fully cw

2. Apply an AC signal to the HORIZONTAL input. Approximately 4 Vpp will extend the full width of the scope face.

3. Turn INTENSITY up until trace appears.

4. Turn Vertical POSITION control alternately cw and ccw. Line should go off the screen in both directions.

5.3.2 HORIZONTAL POSITION CONTROL CHECK

1. Set display controls as follows:

INTENSITY	ccw
HORIZONTAL POSITION	mid range
VERTICAL POSITION	mid range
HORIZONTAL GAIN	mid range
VERTICAL GAIN (switch)	1V/div
VERTICAL GAIN (vernier)	cw

2. Apply an AC signal to the VERTICAL input. Twelve volts peak to peak will extend the full height of the scope face.

CAUTION

Do not turn AUTO BLANK off without a signal to the scope vertical. The result would be a bright dot which would burn the CRT phosphor.

3. Switch AUTO BLANK off.

4. Turn up INTENSITY until trace appears.

5. Turn the Horizontal POSITION control alternately cw and ccw. Line should move off the screen in both directions.

6. Turn AUTO BLANK on. (Line will disappear)

5.3.3 VERTICAL GAIN CHECK

1. Set Display controls as follows:

INTENSITY	fully ccw
HORIZONTAL POSITION	mid range
VERTICAL POSITION	mid range
HORIZONTAL GAIN	mid range
VERTICAL GAIN (switch)	1V/div
VERTICAL GAIN (vernier)	fully cw

2. Make connections as shown in Figure 5-3.

3. Set function generator as follows:

Frequency	1 kHz
Output (Set using calibrated lab scope)	10 Vpp
Mode	continuous
Sweep Time	10 ms

(or set a second generator for 100 Hz)

4. Increase INTENSITY until trace is visible. Adjust the Horizontal GAIN control for a pattern width of 16 divisions. The vertical amplitude on the display should be 10 divisions ±1.

5.3.4 VERTICAL BANDWIDTH CHECK

1-4 Execute steps 1-4 of Vertical Gain check, Section 5.3.3. Set function generator for displayed amplitude of exactly 10 divisions.

5. Increase function generator frequency to 15 kHz (3dB point).

6. Pattern should be at least seven divisions high.

5.3.5 VERTICAL LINEARITY CHECK

1. Set Display controls as follows:

INTENSITY	fully ccw
HORIZONTAL POSITION	mid range

VERTICAL POSITION	mid range
HORIZONTAL GAIN	mid range
VERTICAL GAIN (switch)	1V/div
VERTICAL GAIN (vernier)	fully clockwise

2. Make connections as shown in Figure 5-3.

3. Set function generator controls as follows:

Frequency	1 kHz
Output	1 Vpp
Mode	continuous
Sweep Time	10 ms

(or set a second generator for 100 Hz)

4. Increase INTENSITY until trace is visible. Adjust Horizontal GAIN control for a pattern 16 divisions wide.

5. Set vertical amplitude for one division (at vertical center of screen).

6. Using Vertical POSITION control move one-volt reference up and down. Amplitude should not vary more than .5 division.

5.3.6 HORIZONTAL GAIN CHECK

1. Set Display controls as follows:

INTENSITY	fully ccw
HORIZONTAL POSITION	mid range
VERTICAL POSITION	mid range
HORIZONTAL GAIN	mid range
VERTICAL GAIN (switch)	1V/div
VERTICAL GAIN (vernier)	fully cw

2. Make connections as shown in Figure 5-4.

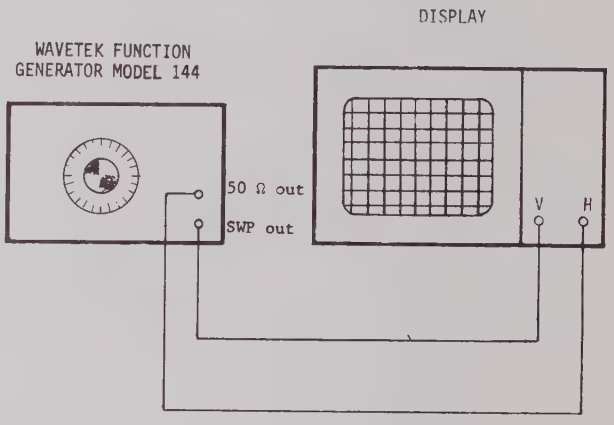


Figure 5-4. Horizontal Gain Check Setup

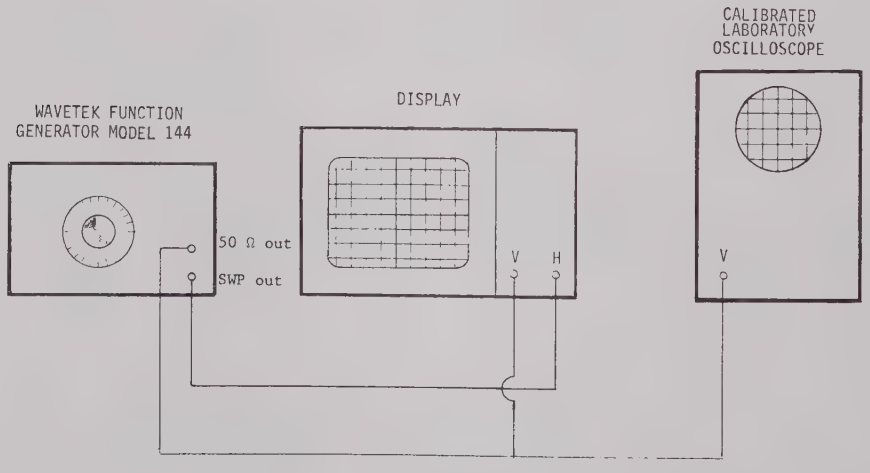


Figure 5-3. Vertical Gain Check Setup

3. Set the function generator as follows:

Frequency	100 Hz
Output Level	1 Vpp
Mode	continuous
Sweep Time	10 ms

(or set a second generator for 100 Hz)

4. Increase INTENSITY until trace is visible. Adjust Vertical GAIN for 12 division signal height.

5. Turn AUTO BLANK off.

6. Turn Horizontal GAIN control from min to max. The pattern should go from 0 to greater than 10 divisions.

5.3.7 HORIZONTAL BANDWIDTH CHECK

1-4 Execute steps 1-4 of 5.3.6 Horizontal Gain Check.

5. Adjust horizontal amplitude to 14 divisions by adjusting input level or Horizontal GAIN.

6. Increase function generator frequency to 1.5 kHz (3dB point). The horizontal amplitude should be at least 9.8 divisions wide.

5.3.8 HORIZONTAL LINEARITY CHECK

1-5 Execute steps 1-5 of 5.3.6 Horizontal Gain Check.

6. Adjust pattern width for 1 division and center it horizontally.

7. Move the displayed pattern from left to right over the full 16 divisions. Its amplitude should not vary more than .5 divisions.

8. Return AUTO BLANK switch to on position.

5.3.9 VERTICAL POLARITY CHECK

1. Apply an AC signal to the Display HORIZONTAL input and center line vertically.

2. Apply to the VERTICAL input a signal with a positive DC offset. The signal should appear in the upper half of the scope face.

3. Pull the Vertical POSITION knob. Signal should move to lower half of screen.

4. Push knob back in.

5.3.10 VERTICAL MARKER CHECK

1. Apply an AC signal of about 100 Hz to the HORIZONTAL input of the scope.

2. Apply a 5 kHz signal of approximately 5 volts p-p to the VERT MARKER input.

3. Rotate marker SIZE control. A signal should be displayed which is variable from 0 to 12 divisions.

5.3.11 INTENSITY MODULATION CHECK

1. Apply sweep output from function generator to Display HORIZONTAL input.

2. Set INTENSITY control for approximately half brightness.

3. Obtain rectangular signal from function generator. Set amplitude for 1 Vpp (±.5V). Set positive time much smaller than negative time.

4. Apply function generator signal to scope INTENSITY MODULATION INPUT on rear panel. The resulting bright areas should appear to be full brightness. The dark areas should be fully blanked.

CAUTION

If a signal is applied to the INTENSITY MODULATION INPUT without applying a Horizontal or Vertical input, the tube phosphor may be burned.

NOTE

If the polarity of this circuit has been internally reversed, change the function generator signal to provide a negative time much smaller than the positive time.

5.4 CALIBRATION PROCEDURE

This section provides the tests and adjustments necessary to align the unit and ensure that it meets its specifications. The procedure is written to be performed completely and in the sequence given. Names of external controls and connectors are written in all capital letters. Refer to Table 5-1 for list of equipment necessary for calibration.

Remove top cover by removing three screws on each side of unit (Figure 5-1) and lifting cover back and up.

Start calibration with controls in the following positions. To facilitate the calibration procedure, the control settings and hookups at the beginning of each step are assumed to be unchanged from the end of the previous step.

FRONT PANEL

INTENSITY	fully ccw (min)
HORIZONTAL POSITION	mid range
VERTICAL POSITION	mid range
HORIZONTAL GAIN	mid range
VERTICAL GAIN (switch)	1V/div
VERTICAL GAIN (vernier)	fully cw

REAR PANEL

AUTO BLANK	ON
VERT MARKER POLARITY	+
VERT MARKER SIZE	fully ccw
INTENSITY CONTRAST	fully cw (max)

Plug line cord into AC supply set for exactly 115 volts. Turn POWER on and allow a five minute warmup before calibrating.

Refer to Figure 5-5 for locations of test points and adjustments.

5.4.1 POWER SUPPLY CHECKS

With lab grade oscilloscope, check +32 V at TP 1 (Fig 5-5). Turn Vertical POSITION control fully clockwise; voltage should be +33 with less than 1 Vpp ripple. Turn control fully counterclockwise; Voltage should be +31 with less than 2 Vpp ripple.

With same scope check -32V at TP 2. Turn Vertical POSITION control fully clockwise; voltage should be -31 with less than 2 Vpp ripple. Turn control counterclockwise; voltage should be -33 with less than 1 Vpp ripple.

With voltmeter, check +15.5 V at TP 3. Reading should be between 14.7 and 16.3 V.

With voltmeter check -15.5 V at TP 4. Reading should be between -14.7 and -16.3 V.

With voltmeter check +68 V at TP 5. Reading should be between 61.2 and 74.8 V.

5.4.2 HIGH VOLTAGE ADJUSTMENT

Read DC voltage on TP 6 with high-impedance (10 Meg) meter. Set voltage for +355 V with High Voltage Adj. pot (see Fig 5.5). Check +9 kV with high-voltage probe by sliding probe under high-voltage connector cover on CRT anode (Figure 5-6). Reading should be between +8.5 kV and +9.5 kV.

5.4.3 INTENSITY LIMIT & FOCUS ADJUSTMENT

Apply square wave 10 Vpp to VERTICAL input and a ramp to HORIZONTAL input. Turn INTENSITY fully clockwise. Adjust horizontal amplitude for 12 divisions and frequency for a stable square-wave pattern.

Turn Intensity Limit control (Figure 5-5) fully counterclockwise. Return clockwise until blooming is 1%. One percent blooming can be determined by allowing the vertical amplitude to increase from 10 to 10.1 divisions. Decrease brightness as desired. Adjust Focus control

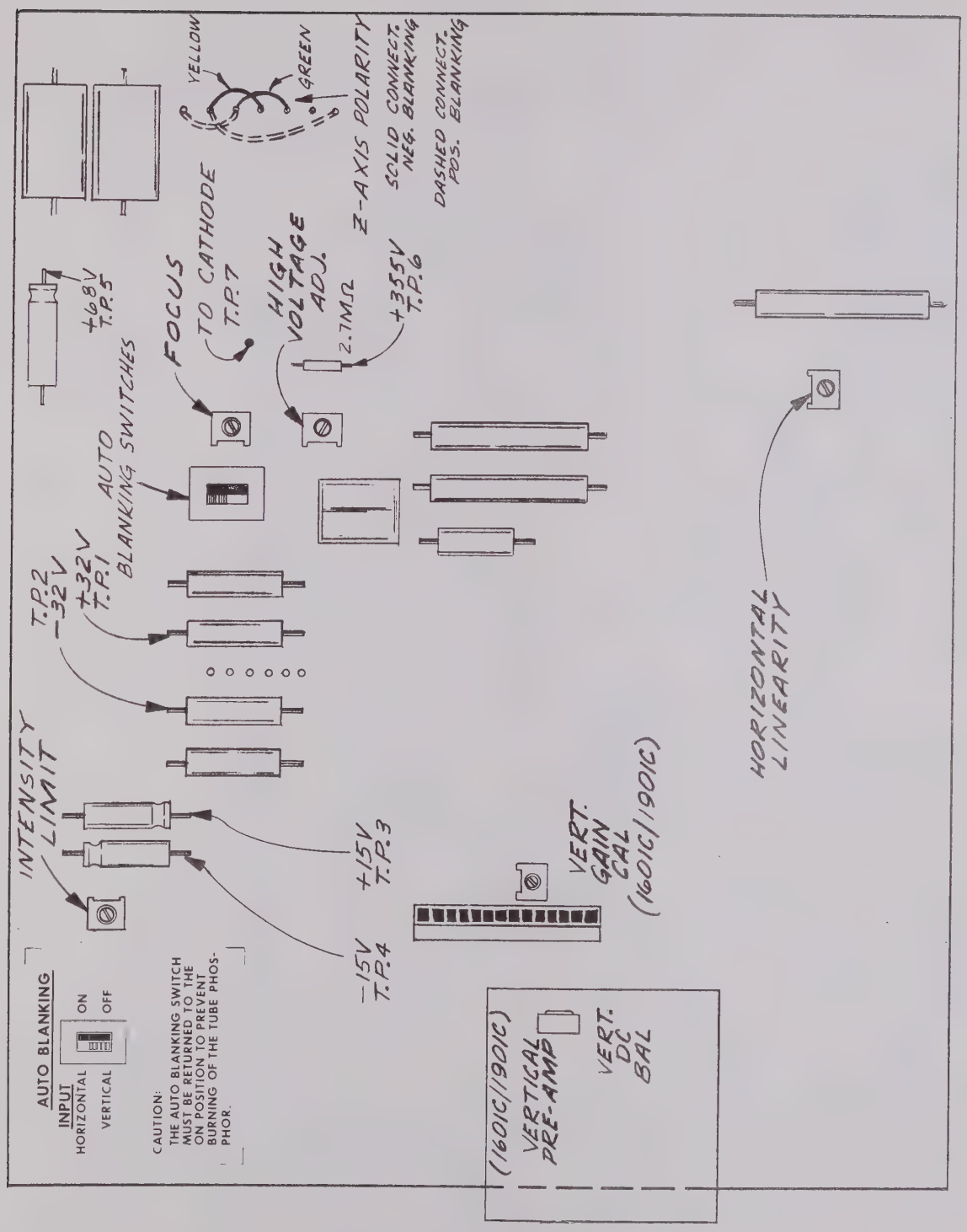


Figure 5-5. Test Points and Adjustments

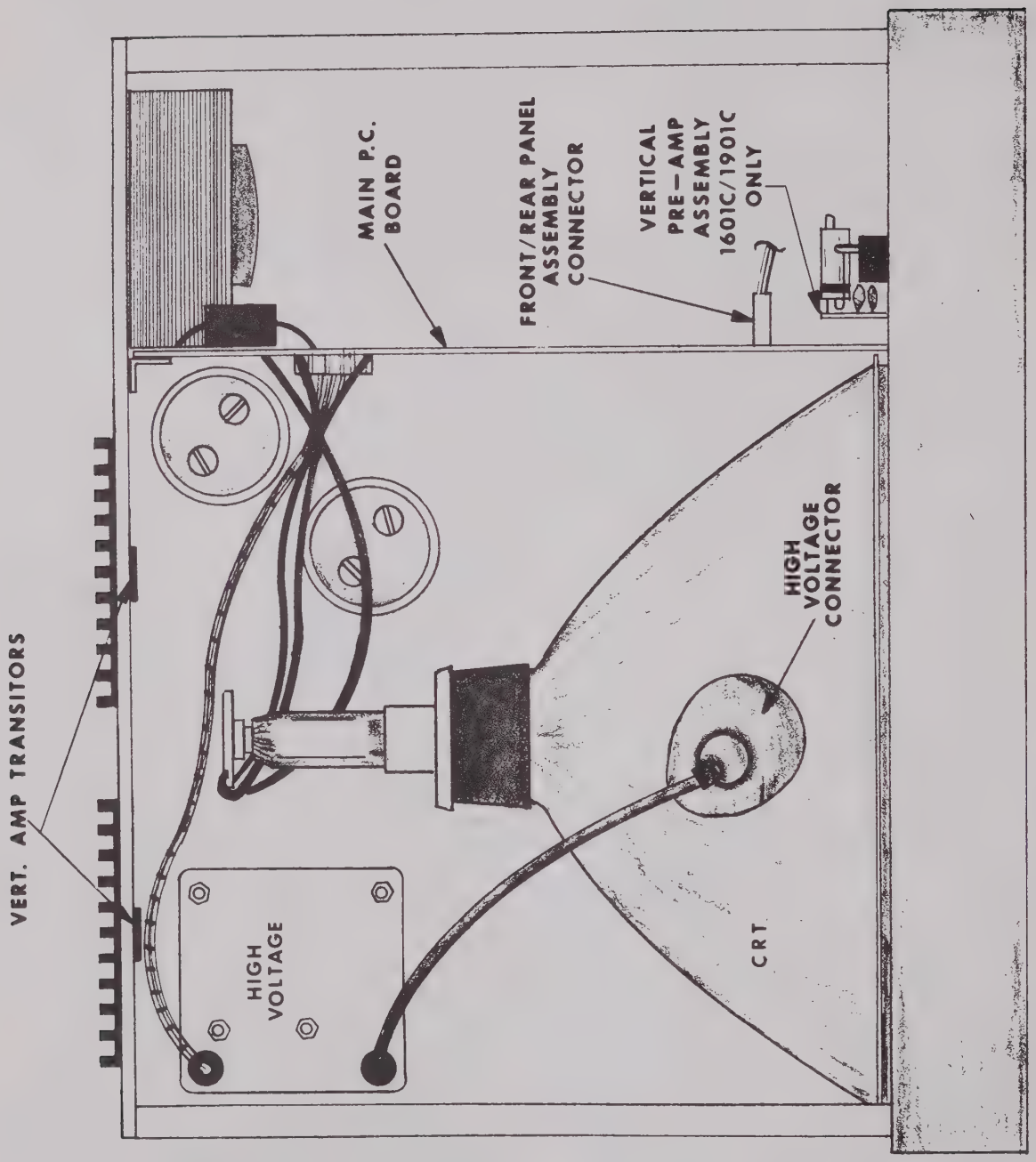


Figure 5-6. Display Top View

(Figure 5-5) for sharpest display. Disconnect vertical signal.

5.4.4 VERTICAL D.C. BALANCE

Increase Horizontal GAIN for 16 division trace. Turn Vertical GAIN vernier fully counterclockwise. Position horizontal line at center graticule with Vertical POSITION control.

Turn Vertical GAIN vernier fully clockwise. With Vert DC Bal (Figure 5-5) return line to center graticule. Start procedure again by turning Vertical GAIN vernier fully counterclockwise. Repeat procedure until there is minimum movement of the line when the Vertical GAIN vernier is turned from one extreme to the other.

5.4.5 VERTICAL GAIN CALIBRATION

Turn Vertical GAIN vernier fully clockwise. Apply a 1 kHz sine wave simultaneously to the VERTICAL input and the vertical input of lab grade scope. Adjust signal generator to 8 Vpp according to the lab scope. Adjust Vert Gain Cal (Figure 5-5) for 8 divisions on Display face.

5.4.6 YOKE ADJUSTMENT

Disconnect vertical signal. Move tabs on yoke until bowing (curvature) is eliminated from horizontal line. Loosen yoke clamp screw until yoke is free to rotate. Rotate yoke until the horizontal line is exactly parallel to the center horizontal graticule. Tighten screw and recheck trace alignment.

5.4.7 VERTICAL LINEARITY CHECK

Set Sweep Time of horizontal signal to 10 ms. Apply a 1 kHz signal to the vertical input. Reduce the amplitude of the signal from the function generator to one division on the scope face. Using the Vertical POSITION control, move this one volt reference up and down. Its amplitude should not vary more than .5 divisions.

5.4.8 HORIZONTAL LINEARITY ADJUSTMENT

Reverse horizontal and vertical inputs. Set frequency of horizontal signal to 100 Hz. Center the display with Vertical and Horizontal POSITION controls. Set vertical amplitude for 5 divisions. Set horizontal amplitude for six divisions. With the Horizontal POSITION control, move the displayed signal to the right until left edge of signal is on the second line to the right of center. The right edge of the signal should fall exactly on the far right (8th) graticule line. Set the position of the right edge of the signal with Horizontal Linearity pot shown in Figure 5-5.

Reduce the horizontal amplitude to one division. (Switch Auto-Blanking selector to the vertical position if trace disappears.) Move the displayed pattern from left to right over the full 16 divisions. Its amplitude should not vary more than .5 divisions. Return Auto-Blanking selector to horizontal position. Disconnect horizontal input.

5.4.9 Z-AXIS GAIN CHECK

Move 10 ms signal from VERTICAL to HORZONTAL input. Feed 100 kHz from the function generator into INTENSITY input. Monitor CRT cathode voltage using Lab Scope with a low-capacity probe. The cathode is connected by the grey wire from the tube to TP 7 on Figure 5-5. Adjust function generator output for 18 Vpp (at cathode). Move probe to INTENSITY input. The input signal should be less than 1 Vpp. Return the probe to the cathode.

Turn CONTRAST fully counterclockwise. Increase function generator input to provide 10 Vpp at cathode. Move probe to input. Signal should be greater than 20 Vpp. Decrease input signal level to 1 Vpp and turn CONTRAST control to max (cw).

5.4.10 Z-AXIS BANDWIDTH

Return probe to cathode. Adjust signal level for 10 Vpp at cathode. Increase input frequency to 1 MHz. Voltage should be 10 ±.2 Vpp. Increase input frequency to 3.5 MHz. Voltage should be greater than 7.1 Vpp. Increase frequency to 10 MHz. Voltage should be greater than 3.2 Vpp.

5.4.11 VERTICAL MARKER CHECK

Apply a 5 kHz signal of approximately 5 volts p-p to the VERT MARKER input. Signal should be about 12 divisions high. Rotate the VERT MARKER SIZE control counterclockwise. Signal should decrease to zero volts. Disconnect signal from MARKER input.

5.4.12 VERTICAL POLARITY CHECK

Center the line with Vertical POSITION control. Apply a signal to the VERTICAL input which has a positive DC offset. The signal should appear on the upper half of the scope face. Pull the Vertical POSITION knob. The signal should move to the lower portion of the screen. Push knob back in.

5.5 TROUBLESHOOTING

5.5.1 GENERAL

A thorough understanding of the block diagram and the theory of operation located in Section 4 may enable the trouble symptom to be associated with a particular circuit or component. Refer to Section 6 for schematic diagrams and to Section 5.2 for disassembly procedure.

5.5.2 PRELIMINARY CHECKS

Equipment troubles are frequently due simply to improper front or rear panel control settings. Refer to the operating instructions in Section 3 for complete explanation of each control's function.

5.5.3 CALIBRATION

After verifying that trouble is not improper setting of the controls or test setup, make a thorough check of the

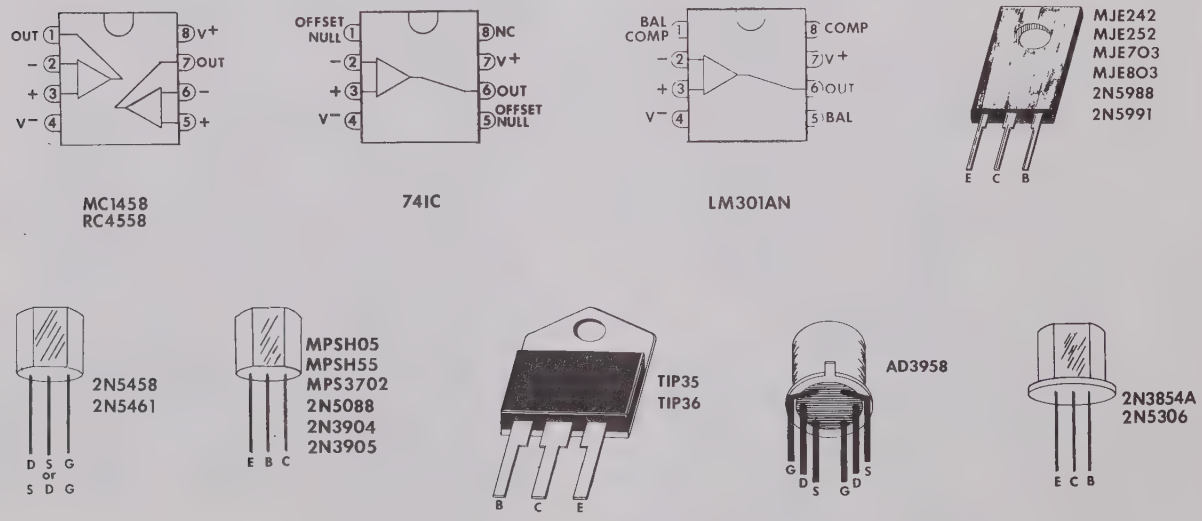


Figure 5-7. Lead Configurations

instrument's calibration by following the procedure in Section 5.4. By performing the calibration procedure, a trouble can be localized to a specific circuit.

5.5.4 VISUAL INSPECTION

After localizing a trouble to a specific area of the unit, make a good visual check of the area. Check for burned or broken components, loose wires or circuit-board connections.

5.5.5 VOLTAGE AND RESISTANCE CHECKS

After localizing the problem, voltage and resistance checks will help find the defective component. See Figure 5-7 for identification of transistor and IC leads. See Figure 5-8 for locations of major components on the main board.

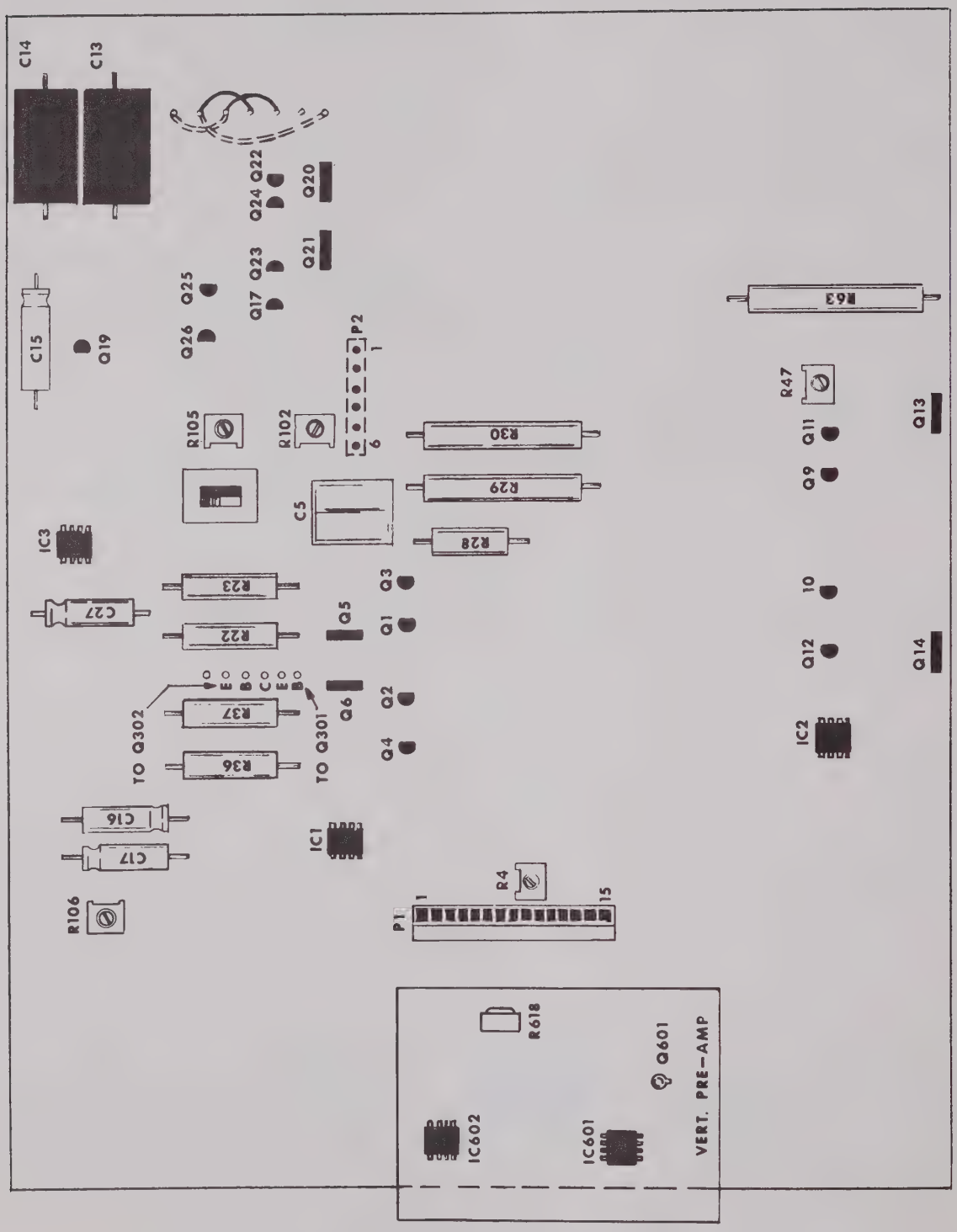
When troubleshooting, care must be taken not to short one of the higher voltage supplies to the ±15.5 volt supplies in order to prevent damage to the op. amps. If trouble is suspected in the high-voltage circuit, the assembly can be disconnected from main board and another high-voltage assembly substituted for the suspected defective one.

5.5.6 REPAIR

When removing components from the printed-circuit board, do not use excessive heat. This can damage the lands on the printed circuit board.

WARNING

If the defective component is the CRT, use extreme care in replacing it. To prevent personal injury, always wear a face mask or goggles and protective gloves.



Figures 5-8. PC Board Component Locations

SECTION 6
REPLACEABLE PARTS

6.1 INTRODUCTION

This section contains schematics and lists of all replaceable parts for the instrument.

For an assembly containing one or more subassemblies, the assembly list appears first, and is followed by the subassembly lists.

The lists appear in the following order.

PARTS LISTS	ASSEMBLY
1010-00-0024	OSCILLOSCOPE
1110-00-0581	MAIN BOARD
1115-00-0006	H.V. POWER SUPPLY
1219-00-0111	H.V. POWER SUPPLY HARNESS
1111-00-0011	CHASSIS
1219-00-0265	HARNESS
1118-00-0008	FRONT PANEL
1118-00-0009	REAR PANEL
1219-00-0024	VERTICAL PRE-AMP

6.2 MANUFACTURERS CODE

The following code is used on the parts lists to identify the manufacturer.

ABBR.	NAME	CITY	ST	FSCM.
A-B	ALLEN-BRADLEY	MILWAUKEE	WI	01121
A-D	ANALOG DEVICES	CAMBRIDGE	MA	24355
A-H	ARROW HART, INC.	KETTERING	OH	07858
A-I	ALAN INDUSTRIES	COLUMBUS	IN	52750
A-M	AMERICAN MAGNETICS	CARTERVILLE	IL	12715
A-P	AMERICAN PLASTICRAFT CO.	CHICAGO	IL	53628
ABAC	ABACUS PACKAGING CO.	CHICAGO	IL	
ACEIN	ACE INDUSTRIAL HDWR.	CAMDEN	NJ	
ACI	ADVANCE COMPONENTS, INC.	CENTERBROOK	CT	28102
AEG-T	AEG-TELEFUREN CORP.	SOMERVILLE	NJ	24972
AEP	APPLIED ENG PRODUCTS	NEW HAVEN	CT	19505
AER	AVX CERAMICS	MYRTLE BEACH	SC	96095
AERTK	AERTECH INDUSTRIES	SUNNYVALE	CA	21847
AFE	ACCESSORIES FOR ELECTRONICS	BALDWIN	NY	
AHAM	AHAM COMPANY	AZUSA	CA	53894
AIN	ALPHA INDUSTRIES, INC.	WOBURN	MA	17540
ALC	ALCO ELECTRONICS PRODUCTS	NORTH ANDOVER	ME	95146
ALLPL	ALL PLASTICS,INC.	INDIANAPOLIS	IN	
ALMPT	ALPHA METALS, INC	JERSEY CITY	NJ	96613
AMATH	AMATOM ELEC HDWE CO	NEW HAVEN	CT	
AMD	ADVANCED MICRO DEVICES INC.	SUNNYVALE	CA	34335
AMELC	AMERICAN ELECTRIC CORDSETS	BENSENVILLE	IL	0
AMP	AMP, INC.	HARRISBURG	PA	00779
AMSLY	ANSLEY ELECTRONICS LTD	DOWNSVILLE, ONT., CANADA	**	
ANZAC	ADAMS-RUSSELL,ANZAC DIV	BURLINGTON	MA	
APL	AMPHENOL CONNECTOR SYSTEMS	BROADVIEW	IL	74868
APP	A-P PRODUCTS	PAINESVILLE	OH	0
APX	AMPEREX ELECTRONIC CORP.	SLATERSVILLE	RI	25403
ARC	ARCO ELECTRIC PRODUCTS	SHELBYVILLE	IN	24652
ARIES	ARIES ELECTRONICS CORP.	FRENCHTOWN	NJ	
ARN	ARNOLD ENGINEERING CO.	MARENGO	IL	95566
AROMT	AROMAT CORP.	ELK GROVE VILLAGE	IL	
ARW-M	ARROW-M CORP	CARSON	CA	
ASBAG	ASSOCIATED BAG CO.	MILWAUKEE	WI	
ASC	ASSOCIATED SPRING	BRISTOL	CT	92830
ASE	AIRCO SPEER ELECTRONICS	ST. MARYS	PA	06560
ASM	ACCURATE SCREW MACHINE CO	NUTLEY	NJ	51506
ASTID	ASTRO INDUSTRIES	DAYTON	OH	29365
AT/IN	ATLANTIC INDIA RUBBER CO	CHICAGO	IL	70485
ATC	AMERICAN TECHNICAL CERAMICS	HUNTINGTON STATN	NY	29990
ATR	ATR COIL CO.	BLOOMINGTON	IN	XXXXX
AUGAT	AUGAT, INC.	ATTLEBORO	MA	91506
AULT	AULT INC.	MINNEAPOLIS	MN	14310
AUTCP	AUTOMATION CORP.	PECKVILLE	PA	
AVDEL	AVDEL FASTENER SYS.	PARSIPPANY	NJ	19738
AVT	AVANTEK, INC.	SANTA CLARA	CA	24539
AWC	ALPHA WIRE	ELIZABETH	NJ	92194
B-T	BEK-TEK, INC.	READING	PA	XXXXX
B-W	BARKER & WILLIAMSON	BRISTOL	PA	05690

ABBR.	NAME	CITY	ST	FSCM.
BOKER	BOKER'S INC.	MINNEAPOLIS	MN	85446
BORDN	BORDEN INC.	COLUMBUS	OH	32283
BOU	BOURNS, INC.	RIVERSIDE	CA	90294
BRAUN	BRAUN MFG CO	CHICAGO	IL	93785
BREZ	BREEZE CORPORATIONS, INC.	UNION	NJ	08484
BSCAN	B-SCAN, INC.	PHILADELPHIA	PA	32198
BSHP	BISHOP GRAPHICS, INC.	WESTLAKE VILLAGE	CA	34730
BUCK	BUCKEYE STAMPING CO.	COLUMBUS	OH	21604
BUD	BUD RADIO, INC.	WILLOUGHBY	OH	71218
BURND	BURNDY CORP.	NORWALK	CT	09922
BUS	BUSSMAN MFG.	ST. LOUIS	MO	71400
BWC	BARON WIRE AND CABLE CORP.	CHICAGO	IL	72622
C-A	CIRCUIT ASSEMBLY CORP	COSTA MESA	CA	52072
C-D	CORNELL DUBILIER ELECT DIV	NEWARK	NJ	14655
C-E	CLINTON ELECTRONICS	ROCKFORD	IL	54972
C-H	CUTLER-HAMMER, INC.	MILWAUKEE	WI	55841
C-I	COMPONENTS, INC.	BIDDEFORD	ME	17554
C-J	TRW/CINCH	ELK GROVE VILLAGE	IL	71785
C-K	C & K COMPONENTS, INC.	WATERTOWN	MA	09353
C-L	CENTRALAB DIV.	MILWAUKEE	WI	71590
C-M	C-M			
C-W	C-W INDUSTRIES	WARMINSTER	PA	79727
CAE	CAPAR COMPONENTS CORP	MELVILLE	NY	
CAI	CUSTOM ACCESSORIES, INC.	SKOKIE	IL	XXXXX
CAM	CAMBION	CAMBRIDGE	MA	71279
CAR	CARLING ELECTRIC, INC.	WEST HARTFORD	CT	73559
CBLWV	CABLEWAVE SYSTEMS, INC.	NORTH HAVEN	CT	16733
CBRDM	CARBORUNDUM INSUL DIV	NIAGARA FALLS	NY	
CCM	CORCOM, INC.	LIBERTYVILLE	IL	05245
CDC	COMPONENT DEVELOPMENT CORP.	CARSON	CA	XXXXX
CECO	CENTRAL COIL CO.	BRAZIL	IN	XXXXX
CFI	CIRCUIT FUNCTIONS INC.	NEWBURY PK	CA	32499
CGW	CORNING GLASS WORKS	CORNING	NY	24546
CHE	CHERRY ELECTRICAL PRODUCTS	WAUKEGAN	IL	01963
CHEMP	CHEMPLAST,INC.	WAYNE	NJ	0
CHLAR	CHARLES LARSON CO.	STERLING	IL	
CHOM	CHOMERICS INC.	WOBURN	MA	18565
CHRY	CHRYSLER CORP.	DETROIT	MI	12204
CIMCO	CIMCO WIRE AND CABLE INC.	ALLENDALE	NJ	XXXXX
CINOX	CINOX CORP	CINCINNATI	OH	58997
CKI	CTS KNIGHTS, INC.	SANDWICH	IL	75378
CLA	CLAIREX CORP.	MT. VERNON	NY	03911
CLAR	CLAROSTAT MFG. CO	DOVER	NH	12697
CLCFT	COILCRAFT	CARY	IL	
CLFRM	COILFORM	GENEVA	IL	20254

ABBR.	NAME.....	CITY.....	ST	FSCM.
CLFX	COLE-FLEX CORP.	BABYLON	NY	56352
CLMRK	CALMARK CORP	SAN GABRIEL	CA	52094
CMLC	CAMLOC FASTENER	PARAMUS	NJ	
CNCRD	CONCORD ELEX	NEW YORK	NY	18310
CNTRN	CENTURION	*****	**	
COL	COLLMER SEMICONDUCTORS INC	DALLAS	TX	
CQORS	COORS PORCELAIN CO	GOLDEN	CO	
CPKG	CREATIVE PKG DIV	INDIANAPOLIS	IN	46203
CPLRD	COMPLETE-READING ELEC.CO.	DALLAS	TX	02358
CRDWL	CARDWELL CONDENSER CORP	LINDENHURST	NY	88356
CRMLY	CERMALLOY	WEST CONSHOHOCKEN	PA	
CRTR	CORE-TRONICS	ORANGE	NJ	29324
CSDC	CONDITIONING SEMICNDTR DVS	WAYNE	NJ	
CTC	COMMUNICATIONS XISTOR CORP	SAN CARLOS	CA	
CTS	CHICAGO TELEPHONE SYSTEMS	CHICAGO	IL	71450
CTS-E	CTS OF ELKHART	ELKHART	IN	71450
CTS-F	C.T.S. OF FAIRBERRY	FAIRBERRY	IL	71450
CTS-K	CTS OF KEENE	PASO ROBLES	CA	11237
CTSBR	CTS OF BERNE	BERNE	IN	11236
CTSBV	CTS OF BROWNSVILLE	BROWNSVILLE	TX	34263
CW/AL	C.W./ALPHA	SOUTHAMPTON	PA	
DAL	DALE TECHNOLOGY CORP.	HARTSDALE	NY	XXXXX
DATEL	DATEL SYSTEMS, INC.	MANSFIELD	MA	50721
DAV	HARRY DAVIES MOLDING CO.	CHICAGO	IL	72512
DAYTN	DAYTON ELECTRIC CO.	CHICAGO	IL	16327
DEL	DELEVAN DIV.	EAST AURORA	NY	XXXXX
DEN	DENNISON MFG. CO.	FRAMINGHAM	MA	16956
DEW	DEWIRE FABRICATING CORP.	LOWELL	MA	13161
DGTRN	DIGITRAN CO.	PASADENA	CA	
DILEC	DILECTRON	MONROVIA	CA	0
DIO	DIODES, INC.	CHATSWORTH	CA	12060
DIXON	DIXON INDUSTRIES INC.	BRISTOL	RI	04813
DK-WR	DAKO-WARE	CHICAGO	IL	
DLGHT	DIALIGHT	BROOKLYN	NY	72619
DLI	DIELECTRIC LABORATORIES INC	CAZENVIA	NY	55153
DLTEK	DELTA ELECTRONICS MFG CO	BEVERLY	MA	00795
DM-GY	DIMCO-GRAY	CENTERVILLE	OH	80813
DNTCH	DONTECH, INC.			
DRA	DRAKE MANUFACTURING CO.	HARWOOD HEIGHTS	IL	71744
DRMYR	DORMEYER	ROCKVILLE	IN	73662
DUPNT	E.I.DUPONT DENEMOURS & CO	WILMINGTON	DE	
DYNR	DYNEER CORP.	CHATSWORTH	CA	
E-C	ELECTRONIC CRYSTALS	KANSAS CITY	MO	18853
E-I	ELECTRICAL INDUSTRIES,INC.	MURRAY HILL	NJ	20093
E-M	ELECTRA/MIDLAND CORP.	MINERAL WELLS	TX	XXXXX
EATON	EATON CORP.	SUNNYVALE	CA	34657
EBY	EBY COMPANY	PHILADELPHIA	PA	72825
ECKDT	ECKARDT LABORATORIES	ORANGE	CA	
ECHC	ELECTRI-CORD MFG. CO. INC.	WESTFIELD	PA	XXXXX
EDAC	EDAC, INC.	DON MILLS, ONT., CANADA	**	31781
EECO	EECO, INC.	SANTA ANA	CA	97525

ABBR.	NAME.....	CITY.....	ST	FSCM.
ELC-I	ELECTRA	CUMBERLAND	IN	
ELCO	ELCO INDUSTRIES	ROCKFORD	IL	83486
ELDRE	ELDRE COMPONENTS, INC	ROCHESTER	NY	19648
ELEXP	ELECT EXPEDITERS	MILWAUKEE	WI	
ELFX	ELECTRO-FLEX HEAT INC.	BLOOMFIELD	CT	02728
ELHDW	ELECTRONIC HARD	FARMINGDALE	NY	
ELNA	ELNA	CARSON	CA	
EM-CM	EMERSON & CUMING,INC	CANTON	MA	
EMRON			S	0
ENTHN	ENTHONE INC.	NEW HAVEN	CT	02258
EPITK	EPITEK ELECTRONICS	KANATA,ONT,CANADA	**	37907
EPOXT	EPOXY TECHNOLOGY, INC.	BILLERICA	MA	33246
ETC	ELECTRONIC TRANSISTOR CORP.	FLUSHING	NY	12045
ETP	ERIE TECHNOLOGICAL PRODUCTS	ERIE	PA	72982
EVRDY	EVEREADY	NEW YORK	NY	
EXAR	EXAR INTEGRATED SYSTEMS	SUNNYVALE	CA	52063
EZLOK	E-Z LOK	GARDENIA	CA	
F-K	THERMWELL PRODUCTS, INC.	FRAMINGHAM	MA	XXXXX
F-S	FEDERAL SCREW	CHICAGO	IL	73734
FAN	FANCOURT & CO.	GREENSBORO	NC	XXXXX
FASTX	FASTEX DIV.,ILL.TOOL WORKS	DES PLAINES	IL	0
FCD	FAIRCHILD	MOUNTAIN VIEW	CA	07263
FCI	FILM CAPACITORS, INC.	PAS SALC	NJ	00686
FJTSU	FUJITSU AMERICA, INC.	LAKE BLUFF	IL	
FNWL	FENWAL	FRAMINGHAM	MA	15801
FRDKS	FREDERICKS CO.	HUNTINGDON VALLEY	PA	
FRK	FRAKO	FRANKFORT, GER.	**	XXXXX
FRTE	FAIR RITE PRODUCTS CORP.	WALLKILL	NY	34899
FRXC	FERROXCUBE DIVISION	SAUGERTIES	NY	02114
FUT	FUTABA			
G-E	GENERAL ELECTRIC	INDIANAPOLIS	IN	24446
G-H	GRAYHILL, INC.	LA GRANGE	IL	81073
G-I	GEN'L INSTRUMENT SEMICNDTR	HICKSVILLE	NY	14963
G-T	GRAND TRANSFORMERS	GRAND HAVEN	MI	02459
GAL	GALILEO ELECTRO-OPTICS	STURBRIDGE	MD	28719
GATES	GATES ENERGY PROD.	DENVER	CO	57053
GBN	GILBERT ENGINEERING CO.,INC	PHOENIX	AZ	82316
GCE	GC ELECTRONICS	ROCKFORD	IL	80112
GHZ	GHZ DEVICES, INC.	CHELMSFORD	MA	
GLOBE	GLOBE	MILWAUKEE	WI	
GNATR	GENERAL ATRONICS CORP.	PHILADELPHIA	PA	07407
GOU	GOULD, INC.	ST. PAUL	MN	55857
GRIES	GRIES REPRODUCER	NEW ROCHELLE	NY	05673
GRIP	GRIPMASTER CO.	MARLBORO	NJ	XXXXX
GRVCO	GROVE COMPANY	DAYTON	OH	
GUDL	GUDEBROD BROS. SILK CO.	CHICAGO	IL	XXXXX
GWNDA	GOWANDA ELEX CORP	GOWANDA	NY	
H-P	HEWLETT-PACKARD	INDIANAPOLIS	IN	28480
HARTW	HARTWELL CORP.	PLACENTIA	CA	0
HDMLD	DAVIES H MOLDING	CHICAGO	IL	
HEL	HELIPOT	ANAHEIM	CA	XXXXX

ABBR.	NAME.....	CITY.....	ST	FSCM.
HEY	HEYMAN MFG. CO.	WAUKESHA	WI	28520
HGHS	HUGHES SOLID-STATE PROD	NEWPORT BEACH	CA	
HHS	HERMAN H. SMITH, INC.	BROOKLYN	NY	83330
HI-G	HI-G INC	WINDSOR LOCKS	CT	02289
HIT	HITACHI AMERICA, LTD.	SAN FRANCISCO	CA	XXXXX
HMLN	HAMLIN	LAKE MILLS	WI	12617
HOLGW	HOLLINGSWORTH SLDRLS TERM.	POTTSTOWN	PA	14726
HOLUB	HOLUB DISTRIBUTING CO.	NEWPORT	KY	XXXXX
HSD	HARRIS CORP. SEMICDR. DIV.	MELBOURNE	FL	27410
HUD	HUDSON TOOL & DIE CO.	NEWARK	NJ	02875
HY/PL	HYDRO PLASTICS INC.	GEORGETOWN	KY	XXXXX
HYSOL	HYSOL CORP	INDUSTRY	CA	12405
HYSYS	HYBRID SYSTEMS	BEDFORD	MA	33256
HYT	HYTRONICS	PINELLAS PARK	FL	29525
IBNCO	INDIANA BOLT AND NUT CO.	INDIANAPOLIS	IN	
ICI	ILLINOIS CAPACITOR INC.	MORTON GROVE	IL	74840
ICO-R	ICO-RALLY	PALO ALTO	CA	
IDC	INTL DIODE CORP.	HARRISON	NJ	16068
IEE	INDUSTRIAL ELECTRONIC ENG	NORTH HOLLYWOOD	CA	05464
IERC	INT'L ELEC. RESEARCH CORP.	BURBANK	CA	98978
INDCP	INDUCTIVE COMPONENTS	HAUPPAUGE	NY	25159
INDEC	INDUSTRIAL ELECTRONIC HDWR.	NEW YORK	NY	97913
INDGL	INDIANA GENERAL	KEASBEY	NJ	72656
INLOK	INTERLOK/WM J PURDY CO.	BURLINGAME	CA	55951
INT	INTERSIL, INC.	CUPERTINO	CA	32293
INTEL	INTEL CORP	SANTA CLARA	CA	34649
INWEB	INTERNATIONAL WEBBING	WHITEHALL	PA	32860
IRC	INTERNATIONAL RESISTANCE CO	PHILADELPHIA	PA	75042
IREC	INT'L RECTIFIER CORP.	LOS ANGELES	CA	81483
ISTMP	ISOTEMP RESEARCH, INC.	CHARLOTTESVILLE	VA	31785
ITRON	ISE ELECTRONICS	ISE,JAPAN	**	0
ITT	INT'L TELEPHONE & TELEGRAPH	W. PALM BEACH	FL	XXXXX
JAMES	JAMES ELECTRONICS	CHICAGO	IL	12749
JAN	JAN HARDWARE MFG. CO.	LONG ISLAND CITY	NY	99813
JEF	JEFFERS	DUBOIS	PA	97469
JEFWC	JEFFERSON WIRE AND CABLE	WORCHESTER	MA	07883
JEW	JEWELL ELECTRICL INST	MANCHESTER	NH	
JFD	JFD ELECTRONICS	BROOKLYN	NY	73899
JFW	JFW INDUSTRIES	BEECH GROVE	IN	56532
JHSN	JOHANSON MFG. CORP.	BOONTON	NJ	91293
JON	E.F. JOHNSON CO.	WASECA	MN	74970
JUDD	JUDD WIRE DIV. ECC	TURNERS FALLS	MA	12703
K-L	KERRIGAN LEWIS MFG.	CHICAGO	IL	73920
K-S	K & S ENGINEERING CO.	CHICAGO	IL	22376
KDI-P	KDI-PYROFILM CORP.	WHIPPANY	NJ	03888
KEENE	KEENE CORP.	NEWARK	DE	52869
KEM	KEMTRON ELECTRON PRODUCTS	NEWBURYPORT	MA	92703
KEY	KEYSTONE ELECTRONIC CORP.	NEW YORK	NY	91833
KID	KIDCO, INC.	MEDFORD	NJ	12126

ABBR.	NAME.....	CITY.....	ST	FSCM.
KIN	KINGS ELECTRONICS	TUCKAHOE	NY	91836
KMYO	KAMAYA OHM	JAPAN	**	
KRYST	KRYSTINEL	PATERSON	NJ	29251
KSTR	KESTER SOLDER DIV.	CHICAGO	IL	09185
KSW	KSW ELECTRONICS	BURLINGTON	MA	52673
KUL	KULKA ELECTRIC CORP.	MT. VERNON	NY	75382
KYCRA	KYOCERA INTERNATIONAL	SAN DIEGO	CA	
LAMB	LAMB INDUSTRIES, INC.	PORTLAND	OR	
LAURN	LAUREN MFG CO.	NEW PHILADELPHIA	OH	56329
LEYSE	LEYSE ALUMINUM CO.	KEWANEE	WI	20218
LIT	LITTELFUSE, INC.	DES PLAINES	IL	75915
LNMST	LINEMASTER SWITCH CORP.	WOODSTOCK	CT	97918
LOCTT	LOCTITE CORP.	NEWINGTON	CT	05972
LRC	LRC ELECTRONICS, INC.	HORNELL	NY	16157
LSI	LUMINESCENT SYSTEMS, INC	LEBANON	NH	16157
LTRNX	LITRONIX	CUPERTINO	CA	50579
M-A	MICROWAVE ASSOCIATES	BURLINGTON	MA	96341
M-D	MILLER DIAL & NAMEPLATE CO.	EL MONTE	CA	74072
M-E	MEPCO ELECTRA, INC.	MORRISTOWN	NJ	19701
M-O	ILLUMINATED PRODUCTS INC.	SANTA ANA	CA	XXXXX
M-P	MICRO PLASTICS INC.	CHATSWORTH	CA	31223
MAL	MALLORY CONTROLS CO.	FRANKFORT	IN	90201
MAND	MANDEX	CHICAGO	IL	98278
MARQ	J. & J. MARQUARDT	TUTTLINGEN, GER.	**	XXXXX
MCMTL	MICROMETALS, INC	ANAHEIM	CA	12856
MCREL	MICRO ELEX LTD	HONG KONG	**	
MD-AM	MID AMERICA	CHICAGO	IL	
MDC	MAIDA DEVELOPMENT CO.	HAMPTON	VA	91984
MDLRS	MIDLAND ROSS	CINCINNATI	OH	57951
MDTC	MODUTEC	NORWALK	CT	32171
MFLCO	MAURICE FRANKLIN LOUVER CO.	PROVIDENCE	RI	
MILN	MILLEN MFG. CO.	NEW YORK	NY	XXXXX
MILSP	MILITARY SPECIFICATION	WASHINGTON	DC	81349
MIN-C	MINI-CIRCUITS	BROOKLYN	NY	15542
MINIS	MINI SYSTEMS	NORTH ATTLEBORO	MA	50316
MINOR	MINOR RUBBER CO.	BLOOMFIELD	NJ	76385
MITEK	MITEK	LEXINGTON	MA	0
MLRJW	J.W. MILLER	COMPTON	CA	96804
MMM	3M COMPANY	ST. PAUL	MN	
MNO	MONSANTO COMM. PROD. DIV.	PALO ALTO	CA	50522
MOL	MOLEX PRODUCTS	LISLE	IL	27264
MORAD	MORGAN ADHESIVES	STOW	OH	17452
MOSTK	MOSTK CORP.	CARROLLTON	TX	50088
MOT	MOTOROLA SEMI. PROD. DIV.	INDIANAPOLIS	IN	04713
MOUS	MOUSER ELECTRONICS	LAKESIDE	CA	50811
MRM	M. ROSS MASON	INDIANAPOLIS	IN	
MRO	MICRO SWITCH DIV.	FREEPORT	IL	91929
MRRUB	MARION RUBBER PROD.	INDIANAPOLIS	IN	
MSN	MICROSONICS DIV.	WEYMOUTH	MA	11869
MSP	MICRO SEMICONDUCTOR CORP.	SANTA ANA	CA	14552

ABBR.	NAME.....	CITY.....	ST	FSCM.
MULSO	MULTICORE SOLDERS LTD.	WESTBURY	NY	03051
MURA	MURA	WESTBURY	NY	32539
MURGA	MURATA-GEORGIA	MARIETTA	GA	51406
MWS	MAGNET WIRE SUPPLY CO.	CHATSWORTH	CA	51668
MWS-P	MWS PRECISION WIRE INDUS	WESTLAKE VILLAGE	CA	
MYERS	MYERS SPRING CO.	LOGANSPORT	IN	91956
N-T	NATIONAL TEL-TRONICS	LAREDO	TX	XXXXX
NAT	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	27014
NCC	NATIONAL CERAMIC CO	TRENTON	NJ	76626
NCSVC	NATL COM SERV.	WILLOW GROVE	PA	
NEC	NIPPON ELECTRIC CO.	TOKYO, JAPAN	**	18324
NEL	NATIONAL ENGINEERING LABS	INDIANAPOLIS	IN	XXXXX
NEMCO	NEMCO METALS, INC	MANVILLE	RI	
NEW	NEWARK ELECTRONICS	INDIANAPOLIS	IN	XXXXX
NHWC	NEW HAVEN WIRE & CABLE	NEW HAVEN	IN	XXXXX
NICHN	NICHICON (AMERICA) CORP.	SCHAUMBURG	IL	55680
NMB	NMB CORP.	ARLINGTON HEIGHTS	IL	60005
NMC	MAGNUM MICROWAVE CORP.	SUNNYVALE	CA	59277
NPC	NUCLEONIC PRODUCTS CO.	CANOGA PARK	CA	0
NRTLK	NORTHLAKE ENG, INC	ANTIOCH	IL	50638
NYLO	NYLOMATIC	MORRISVILLE	PA	XXXXX
O-G	OPTI-GAGE INC.	DAYTON	OH	XXXXX
O-S	OMNI SPECTRA INC.	FARMINGTON	MI	16179
OAK	OAK INDUSTRIES INC.	CRYSTAL LAKE	IL	76854
OHM	OHMITE MFG. CO.	SKOKIE	IL	44655
OMEGA	OMEGA WIRE & CABLE	HARLEYSVILLE	PA	XXXXX
OPTO	OPTO ELECTRONICS INC	FT LAUDERDALE	FL	
OPTRN	OPTRON INC.	CARROLLTON	TX	XXXXX
P-B	POTTER AND BRUMFIELD	PRINCETON	IN	77342
P-C	POWER COMPONENTS	WOODLAND HILLS	CA	XXXXX
P-K	PARKER KALON CORP.	CLIFTON	NJ	XXXXX
P-T	PENN TUBE PLASTICS CO.	CLIFTON HEIGHTS	PA	0
P-U	PROJECTS UNLIMITED INC.	DAYTON	OH	XXXXX
POLPH	POLYPHASE INSTR. CO.	BRIDGEPORT	PA	0
PACTC	PACTEC DIV.	PHILADELPHIA	PA	
PAM	PAMOTOR DIV.	BURLINGAME	CA	23936
PAND	PANDUIT CORP.	TINLEY PARK	IL	06383
PARA	PARAMETRIC INDUSTRIES	NORTHFIELD	IL	XXXXX
PCC	PANEL COMPONENTS CORP.	BERKELEY	CA	00000
PEC	PACIFIC ELECTRICORD CO.	GARDENA	CA	80126
PEM	PENN ENGRG & MANUF CO.	DANBORO	PA	
PFZR	PFIZER,INC,	NEW YORK	NY	86491
PHC	PHILADELPHIA HANDLE CO.	CAMDEN	NJ	XXXXX
PHILP	PHILPOTT RUBBER CO.	CLEVELAND	OH	86510
PIC	PIHER INTERNATIONAL CORP.	ARLINGTON HEIGHTS	IL	54869
PIEZO	PIEZO TECHNOLOGIES, INC.	ORLANDO	FL	
PLI	PRECISION LAMP, INC.	MT. VIEW	CA	48451
PLSSY	PLESSEY ENG.	SCHILLER PARK	IL	55112
PLSTI	PLASTIC TECHNIQUES, INC	NEW BOSTON	NH	
PLYCL	POLYCLAD LAMINATES	SOUTHFIELD	MI	
PMCL	PERMACEL DIV.	NEW BRUNSWICK	NJ	99742

ABBR.	NAME.....	CITY.....	ST	FSCM.
PMI	PRECISION MONOLITHICS INC.	SANTA CLARA	CA	06665
PNSNC	PANASONIC			
POLPH	POLYPHASE INSTR,CO	BRIDGEPORT	PA	98330
POM	POMONA ELECTRONICS CO.,INC	POMONA	CA	05276
PREH	PREH VERT,MRH	GERMANY	**	
PRMD	PYRAMID INDUSTRIES, INC.	PHOENIX	AZ	XXXXX
PRRES	PRECISION RESISTIVE PRDTS	MEDIAPOLIS	IA	
PRSLK	PRESTO-LOCK	GARFIELD	NJ	77386
PRSN	PRECISION TUBE CO., INC	NORTH WALES	PA	82413
PTN	PENN TRAN CORP.	BELLEFONT	PA	XXXXX
PWRMT	POWER-MATE CORP.	HACKENSACK	NJ	
PYRO	PYROFILM CORP.	WHIPPANY	NY	XXXXX
PYTT	PYTTRONICS INDUSTRIES, INC.	MONTGOMERYVILLE	PA	31924
Q-C	QUALITY COMPONENTS	ST. MARYS	PA	95121
R-E	ROBISON ELECTRONICS	SAN LUIS OBISPO	CA	
R-N	ROBINSON-NUGENT	NEW ALBANY	IN	0
R-OHM	R-OHM	IRVINE	CA	57668
RAF	RAF ELECTRONIC HDWE	STRAFFORD	CT	
RAWST	RAW STOCK	#####	**	
RAY	RAYTHEON	INDIANAPOLIS	IN	49956
RAYVC	RAY-O-VAC/DV	MADISON	WI	
RBRCT	RUBBERCRAFT	#####	**	
RCA	RCA	CAMDEN	NJ	02735
RCHLK	RICHLOK CORP	CHICAGO	IL	
REL	RELIANCE MICA CO.	BROOKLYN	NY	08530
RGNCY	REGENCY ELECTRONICS, INC.	INDIANAPOLIS	IN	
RGR	ROGERS CORP.	CHANDLER	AZ	31745
RICH	RICHCO PLASTIC CO.	CHICAGO	IL	06915
RICHM	RICHARDS METAL PRODUCTS	WOLCOTT	CT	19076
RMC	RADIO MATERIALS CORP.	CHICAGO	IL	82560
RMF	RMF PRODUCTS INC.	BATAVIA	IL	XXXXX
ROCKW	ROCKWELL INTL.	ANAHEIM	CA	33085
ROGAN	ROGAN CORP.	NORTHBROOK	IL	86797
ROTRN	ROTRON INC.	WOODSTOCK	NY	82877
RPBLC	REPUBLIC ELECTRONICS CORP	PATTERSON	NJ	
RSSLL	RUSSELL	OCEANSIDE	NY	24324
RTNA	ROSENTHAL TECHNIK,N.A.	PROVIDENCE	RI	
S-C	SPECIALTY CONNECTOR	INDIANAPOLIS	IN	24931
S-G	STANDARD GRIGSBY	AURORA	IL	82104
S-I	SWITCHCRAFT, INC.	CHICAGO	IL	82389
S-S	SERVICE SUPPLY	INDIANAPOLIS	IN	XXXXX
S-T	SARKES TARZIAN	BLOOMINGTON	IN	51589
SAE	STANFORD APPLIED ENG	SANTA CLARA	CA	
SAGE	SAGE LABORATORIES, INC.	NATIC	MA	
SAYRO	SAYROSA ENGINEERS LTD.	ALTON, HANTS, U.K	**	04180
SCBE	SCANBE DIVISION	EL MONTE	CA	18677
SCC	STACKPOLE CARBON CO.	ST. MARYS	PA	78488
SCX	SILICONIX INC.	SANTA CLARA	CA	17856
SEAST	SEASTROM MFG. CO.	GLENDALE	CA	86928
SECR	SECOR INC.	WESTWOOD	NJ	0

ABBR.	NAME.....	CITY.....	ST	FSCM.
TFI	T&F INDUSTRIES DIV.	ROLLING MEADOWS	IL	58933
THR	THERMALLOY CO.	DALLAS	TX	13103
TIMES	TIMES WIRE AND CABLE	CINCINNAI	OH	XXXXX
TIN	TINNERMAN PRODUCTS, INC.	CLEVELAND	OH	78553
TKN	TECHNICAL WIRE	CRAWFORD	NJ	XXXXX
TLNC	TELONIC ALTAIR	LAGUNA BEACH	CA	04423
TLSBY	TILSBY	*****	**	
TOKO	TOKO AMERICA	SKOKIE	IL	
TORCO	TOR CORP.	VAN NUYS	CA	XXXXX
TR-UT	TRIAD-UTRAD DIV.	HUNTINGTON	IN	0
TRIYX	TRIONYX INDUSTRIES	INDIANAPOLIS	IN	
TRNSN	TRANSENE CO., INC.	ROWLEY	MA	53796
TRU	WALDES TRUARC	LONG ISLAND CITY	NY	79136
TRW	TRW CAPACITOR DIV.	OGALLALA	NB	84411
TSHBA	TOSHIBA AMERICA INC	WAYNE	NJ	00000
TUSNX	TUSONIX, INC.	TUCSON	AZ	59660
TVL	TEL-VISION LABS	WAUCONDA	IL	0
TWAY	TWAY COMPANY	INDIANAPOLIS	IN	0
TYTON	TYTON CORP.	MILWAUKEE	WI	
U-C	UNIVERSAL COMPONENTS	LOS ANGELES	CA	82933
ULSP	UNDERWRITERS LAB. SPEC.	CHICAGO	IL	0
UNCAR	UNION CARBIDE COMPONENTS	GREENVILLE	SC	57185
UNCHM	UNITED CHEMI-CON			
UNIC	UNICORP	ORANGE	NJ	04729
UNIT	UNITRODE CORP.	WATERTOWN	MA	12969
USECO	USECO DIV.	VAN NUYS	CA	88245
UTK	UNITRACK DIV.	UPPER DARBY	PA	XXXXX
VAC	VACTEC INC.	MARYLAND HEIGHTS	MO	18178
VACO	VACO PRODUCTS CO.	NORTHBROOK	IL	79061
VAR	VARADYNE CAPACITOR DIV.	SANTA MONICA	CA	26654
VARIL	VARI-L CO.	DENVER	CO	05375
VARO	VARO SEMICONDUCTOR INC	GARLAND	TX	
VCTRN	VECTRON LABORATORIES,INC.	NORWALK	CT	27802
VELCR	VELCRO USA INC	NEW YORK	NY	11153
VIC	VICTOREEN INC	CLEVELAND	OH	
VISCM	VISUAL COMM	PLAYA DEL REY	CA	56769
VLIER	VLIER ENGINEERING CORP.	BURBANK	CA	01226
VLTRX	VOLTREX	*****	**	
VONGT	VONNEGUT HARDWARE	INDIANAPOLIS	IN	XXXXX
VRN	VERNITRON CORP.	GREAT NECK	NY	XXXXX
VSSNC	VIEWSONICS, INC.	SYOSSET	NY	59108
VTRMN	VITRAMON, INC.	BRIDGEPORT	CT	95275
W-E	WELLS ELECTRONICS	SOUTH BEND	IN	14329
W-I	WAVETEK INDIANA, INC.	BEECH GROVE	IN	34280
WAG	WAGNER ELECTRIC CORP.	ST. LOUIS	MO	63477
WBSH	WABASH RELAY & ELECT.	WABASH	IN	18542
WECK	WECKESSER CO., INC.	CHICAGO	IL	95987
WHBRY	W.H.BRADY INDL PRDS DIV	MILWAUKEE	WI	
WHTMN	WHITMAN	CINCINNATI	OH	
WKFLD	WAKEFIELD ENGINEERING	WAKEFIELD	MA	05820
WLDM	WALDOM	CHICAGO	IL	92219
WNBG	W.N. BERG	ROCKAWAY	NY	
WNSL	WEINSCHEL ENGINEERING	GAITHERSBURG	MD	93459

ABBR.	NAME.....	CITY.....	ST	FSCM.
SEL	SEALECTRO CORP.	MAMARONECK	NY	98291
SEM	SEMTECH	NEWBURY PARK	CA	14099
SEMTX	SEMTEX	DAYTON	OH	0
SENST	SENSOTEC INC	COLUMBUS	OH	51518
SGM	SIGMA INSTRUMENTS	BRAINTREE	MA	72421
SGS-A	SGS-ATES COMP ELET SPA	AGRATE BRIANZE, ITALY	**	
SHAM	SHAMROCK PLASTICS & RUBBER	INDIANAPOLIS	IN	XXXXX
SHDW	I.E.E. SCHADOW	EDEN PRAIRIE	MN	
SHKMN	SHACKMAN INSTRUMENTS	CHESHAM, ENGLAND	**	0
SHURE	SHURE BROS, INC.	EVANSTON	IL	
SIEM	SIEMENS	ISELIN	NJ	25088
SIG	SIGNETICS CORPORATION	SUNNYVALE	CA	18324
SIGPT	SIGMA PLASTRONICS	DEARBORN	MI	
SINCR	SINCLAIR & RUSH, INC.	ST. LOUIS	MO	15819
SKDRV	STOCK DRIVE PROD. DIV.	NEW HYDE PARK	NY	
SLCGN	SILICON GENERAL INC	GARDEN GROVE	CA	34333
SLT	SOLITRON/MICROWAVE DIV.	PORT SALERNO	FL	95077
SMTC	SAMTEC INC.	NEW ALBANY	IN	55322
SNSTK	SENSOR TECHNOLOGY CO	SEATTLE	WA	
SOART	STATE OF THE ART, INC	STATE COLLEGE	PA	56235
SOURU	SOURIAU	VAN NUYS	CA	
SOUTH	SOUTHCO FASTENERS	LESTER	PA	94222
SPE	SPECTROL	DAYTON	OH	02111
SPEC	SPECTRUM CONTROL, INC.	FAIRVIEW	PA	33095
SPPRD	SPECIALTY PRODUCTS	INDIANAPOLIS	IN	
SPR	SPRAGUE ELECTRIC CO.	INDIANAPOLIS	IN	56289
SPRTX	SUPERTEX INC.	CUPERTINO	CA	0
SPST	SPECTRA-STRIP	GARDEN GROVE	CA	08261
SPY	SPYRAFLO INC	PEACHTREE CITY	GA	
SSS	SOLID STATE SCIENTIFIC	MONTGOMERYVILLE	PA	31019
STC	SILICON TRANSISTOR CORP	CHELMSFORD	MA	
STDPS	STANDARD PRESSED STEEL	JENKINTOWN	PA	03680
STI	SEMICNDTR TECHNOLOGY INC	STUART	FL	
STKFS	STAKE FASTENERS	SOUTH EL MONTE	CA	
STR	STETTNER TRUSH CO.	CAZENOVIA	NY	52763
STSA	STEEL SALES	INDIANAPOLIS	IN	XXXXX
SULL	SULLINS ELECTRONICS CORP	SAN MARCOS	CA	
SXNBG	SAXONBURG CERAMICS	SAXONBURG	PA	
SYL	GTE SYLVANIA	WALTHAM	MA	94131
SYN	SYNTRONIC INSTRUMENTS	ADDISON	IL	99409
SYNTC	SYNTAC CORP.	CLEVELAND	OH	
SYNTK	SYNERTEK	**	*	
SYS	SYSCON INTERNATIONAL, INC.	SOUTH BEND	IN	32436
T-B	THOMAS & BETTS	RARITAN	NJ	59730
T-I	TEXAS INSTRUMENTS	DALLAS	TX	01295
TAPP	TAPE PRODUCTS, INC	*****	**	
TCPL	TACONIC PLASTIC	PETERSBURG	NY	59688
TEK	TEKTRONIX	INDIANAPOLIS	IN	80009
TEKA	TEKA PRODUCTS INC.	COLLEGE POINT	NY	58050
TEKNT	TECKNIT	CRANFORD	NJ	
TELE	TELETYPE CORP.	ELK GROVE VILLAGE	IL	XXXXX
TELRY	TELEDYNE RELAYS	HAWTHORNE	CA	11532

ABBR.	NAME.....	CITY.....	ST	FSCM.
WNZLR	WINZLER MFG	CHICAGO	IL	09109
WRC	WIRE RESEARCH CORP	SANTA ANA	CA	
WSD	WAVETEK	SAN DIEGO	CA	23338
WSTN	WESTON COMPONENTS	ARCHBALD	PA	94075
ZEN	ZENITH RADIO CORP.	CHICAGO	IL	67177
ZERO	ZERO MANUFACTURING CO.	BURBANK	CA	98376
ZIE	ZIERICK MFG. CORP.	MOUNT KISCO	NY	79963
ZPT	ZIPPERTUBING, CO.	LOS ANGELES	CA	07240

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
F220V	FUSE,SLO BLO,1 AMP, 250V	MDL-1	BUS	2410-05-0005	1.000
HH01	HARNESS ASSY	WY1601C	W-I	1219-00-0025	1.000
HH02	HARNESS,WY1601CB	WY1601CB	W-I	1219-00-0265	1.000
HH03	HARNESS,WY1601CC	WY1601CC	W-I	1219-00-0266	1.000
HH04	HARNESS,WY1601CD	WY1601CD	W-I	1219-00-0267	1.000
PS01	HV PWR SPLY,HV309-1	1601C-HV	W-I	1115-00-0006	1.000
ZA01	MAIN BOARD ASSY	1601C-MAIN BD	W-I	1110-00-0581	1.000
ZA02	FRONT PANEL ASSY	A500-363	W-I	1118-00-0008	1.000
ZA03	REAR PANEL ASSY	A500-364	W-I	1118-00-0009	1.000
ZA04	CHASSIS ASSY	A500-362	W-I	1111-00-0011	1.000

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	OSCILLOSCOPE,SNGL TR	1010-00-0024	H
		PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	GRIPLET-FUNNEL,.070 HT123-000	47299	BER	2112-19-0003	82.000
C02	CAP,DISC,1KV,15PF	10TCC-Q15	SPR	1510-10-0150	1.000
C03 C08	CAP,DISC,100V,.1UF	TGP-10	SPR	1510-10-2104	2.000
C04	CAP,DISC,1KV,25PF	60C0G250J	MDC	1510-10-0250	1.000
C05	CAP,MYLR,100V,1UF	225P10591YD3	SPR	1510-60-4104	1.000
C07	CAP,DISC,1KV,100PF	10TCU-T10	SPR	1510-10-3101	1.000
C10 C12 C26	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	3.000
C11	CAP,TANT,25V,1UF	100DE105K25A2	ACI	1510-21-7010	1.000
C13 C14	CAP,ELEC,250V,20UF	WBR20-250	C-D	1510-20-6200	2.000
C15	CAP,ELEC,100V,25UF	TT100X25	MAL	1510-21-3250	1.000
C16 C17	CAP,ELEC,25V,100UF	TE1211	SPR	1510-20-4101	2.000
C18 C19 C21	CAP,DISC,1KV,.01UF	5GA-S10	SPR	1510-10-1103	3.000
C22 C23 C09	CAP,DISC,1KV,470PF	60U471M	MDC	1510-10-1471	3.000
C24	CAP,DISC,1KV,200PF	5GA-T20	SPR	1510-10-1201	1.000
C25	CAP,DISC,1KV,68PF	68U2J680J	MDC	1510-10-3680	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C27	CAP,ELEC,50V,50UF	TE1307	SPR	1510-20-5500	1.000
CR01 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR02 CR20 CR27 CR28 CR03 CR39 CR04 CR40 CR41 CR05 CR06 CR07 CR08 CR09	DIODE,SIGNAL	1N914	G E	4807-01-0914	25.000
CR21 CR22 CR23 CR24 CR29 CR30 CR31 CR42 CR43	DIODE,RECT,400V	1N4004	P-C	4806-01-4004	9.000
CR32 CR33 CR34 CR35	DIODE,RECT,200V	1N5624	G E	4806-01-5624	4.000
CR36 CR37	DIODE,ZENER,16V	1N4745A	ITT	4801-01-4745	2.000
CR38	DIODE,ZENER,68V	1N4760	MOT	4801-02-0004	1.000
IC01 IC02	DUAL OP AMP,RAY ONLY	RC4558NB-RAY	RAY	7000-45-5801	2.000
IC03	OP AMP	N5741CV	SIG	7000-57-4100	1.000
P01	CONN,15-PIN,KONEKTON MC000-080	09-65-1151	MOL	2112-05-0003	1.000
P02	CONN,6-PIN KONEKTON	09-65-1068	MOL	2112-05-0009	1.000
Q01 Q12 Q04 Q09	TRANS QA039-040	2N3904	NAT	4901-03-9040	4.000
Q10 Q11 Q02 Q03	TRANS QA039-050	2N3905	NAT	4901-03-9050	4.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q17 Q25	TRANS QB000-032	MPS-H05	MOT	4902-00-0050	2.000
Q19 Q26	TRANS QB000-027	MPS-H55	MOT	4902-00-0550	2.000
Q20 Q06	TRANS QB000-023	MJE242	MOT	4902-00-2420	2.000
Q21 Q05	TRANS QB000-022	MJE252	MOT	4902-00-2520	2.000
Q22	TRANS QB000-026	AD3958	A-D	4902-03-9580	1.000
Q23	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1.000
R04 R102	POT,CONT,100K RP131-410	360T104B	CTS	4610-00-3104	2.000
R10 R11 R45 R46 R93	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	5.000
R12 R13 R07	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	3.000
R15 R16 R51 R52	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	4.000
R18 R31 R54 R65	RES,C,1/4W,5%,2K	CF1/4-2K	ASE	4700-15-2001	4.000
R20 R33	RES,C,1/4W,5%,620	CF1/4-620	ASE	4700-15-6200	2.000
R22 R23 R36 R37	RES,WW,5W,5%,1	243E1R05	SPR	4702-35-1008	4.000
R24 R59	RES,C,1/4W,5%,2.7K	CF1/4-2.7K	ASE	4700-15-2701	2.000
R27 R61	RES,C,1/2W,5%,220	CF1/2-220	ASE	4700-25-2200	2.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R28 R62	RES,C,2W,10%,1K	HB1021	A-B	4700-46-1001	2.000
R29	RES,WW,10W,5%,50	247E5005	SPR	4702-75-5009	1.000
R30	RES,WW,10W,5%,1	247E1R05	SPR	4702-75-1008	1.000
R41	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R43	RES,C,1/2W,5%,470K	CF1/2-470K	ASE	4700-25-4703	1.000
R47	POT,250K,RP131-425	360T254B	CTS	4610-00-3254	1.000
R48 R05 R06 R94	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	4.000
R49	RES,C,1/4W,5%,27K	CF1/4-27K	ASE	4700-15-2702	1.000
R56 R69	RES,C,1W,5%,3	GB3065	A-B	4700-35-3008	2.000
R63	RES,WW,10W,5%,200	247E2015	SPR	4702-75-2000	1.000
R64	RES,WW,3W,5%,5	242E5R05	SPR	4702-55-5008	1.000
R70	RES,C,1/2W,5%,430	CF1/2-430	ASE	4700-25-4300	1.000
R71	RES,C,2W,5%,220	HB2215	A-B	4700-45-2200	1.000
R72	RES,C,2W,5%,120	HB1215	A-B	4700-45-1200	1.000
R81	RES,C,2W,10%,15K	HB1531	A-B	4700-46-1502	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	><	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R88	RES,C,1/4W,5%,220K		CF1/4220K	ASE	4700-15-2203	1.000
R90	RES,C,1/4W,5%,2.2M		CF1/4-2.2M	ASE	4700-15-2204	1.000
R95	RES,C,1/2W,5%,2.2K		CF1/2-2.2K	ASE	4700-25-2201	1.000
R96 R98	RES,C,2W,10%,150		HB1511	A-B	4700-46-1500	2.000
R97 R99	RES,C,1/4W,5%,3.3K		CF1/4-3.3K	ASE	4700-15-3301	2.000
R100	RES,C,1/2W,5%,2.7M		ED2755	A-B	4700-25-2704	1.000
R101	RES,C,1/4W,5%,910K		CF1/4-910K	ASE	4700-15-9103	1.000
R103	RES,C,1/4W,5%,330K		CF1/4-330K	ASE	4700-15-3303	1.000
R104	RES,C,1/2W,5%,1M		CF1/2-1M	ASE	4700-25-1004	1.000
R106	POT,10K,RP131-310		360T103B	CTS	4610-00-3103	1.000
R106	POT,1M,RP131-510		360T105B	CTS	4610-00-3105	1.000
R107 R108	RES,C,1/4W,5%,1.5K		CF1/4-1.5K	ASE	4700-15-1501	2.000
R109 R111 R17 R32 R53 R66 R83	RES,C,1/4W,5%,470		CF1/4-470	ASE	4700-15-4700	7.000
R110 R115	RES,C,1/4W,5%,390		CF1/4-390	ASE	4700-15-3900	2.000
R112 R113 R91	RES,C,1/4W,5%,220		CF1/4-220	ASE	4700-15-2200	3.000

REFERENCE DESIGNATORS	PART DESCRIPTION	><	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R114	RES,C,1/4W,5%,1.2K		CF1/4-1.2K	ASE	4700-15-1201	1.000
R116	RES,C,1/4W,5%,2.2K		CF1/4-2.2K	ASE	4700-15-2201	1.000
R117	RES,C,1/2W,5%,15K		CF1/2-15K	ASE	4700-25-1502	1.000
R118 R14 R19 R21 R25 R26 R34 R35 R50 R55 R57 R58 R60 R67 R68 R82	RES,C,1/4W,5%,1K		CF1/4-1K	ASE	4700-15-1001	16.000
R119	RES,C,1/4W,5%,3.9K		CF1/43.9K	ASE	4700-15-3901	1.000
R120 R44 R08 R09 R92	RES,C,1/4W,5%,10K		CF1/4-10K	ASE	4700-15-1002	5.000
R121 R122	RES,VAL DET IN CALIB		RES,TRIM	W.I	4799-99-9999	2.000
S01	SWITCH,SLIDESS000-005		SS-191-21	SCC	5105-00-0005	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	GRIPLET-FUNNEL,.070 HT123-000	47299	BER	2112-19-0003	12.000
C201	CAP,ELEC,50V,10UF	TE1304	SPR	1510-20-5100	1.000
C202	CAP,ELEC,50V,50UF	TE1307	SPR	1510-20-5500	1.000
C203	CAP,ELEC,25V,100UF	TE1211	SPR	1510-20-4101	1.000
C204	CAP,MYLR,200V,.22UF	WMF2P22	C-D	1510-60-0224	1.000
C205	CAP,MYLR,200V,.1UF	WMF2P1	C-D	1510-60-0104	1.000
C206	CAP,MYLR,100V,.15UF	WMF1P15	C-D	1510-60-2154	1.000
C207	CAP,DISC,1KV,.01UF	5GA-S10	SPR	1510-10-1103	1.000
C208 C209 C210 C211	CAP,DISC,6KV,560PF	E62U561M6KV	MDC	1510-10-6561	4.000
CR201	DIODE,RECT,400V	1N4004	P-C	4806-01-4004	1.000
CR202 CR203 CR204 CR205 CR206	DIODE,RECT,7000V	G7F-7KV-10MA-150NS	GAL	4806-02-0070	5.000
HH201	HARNESS,HV309-1	WYHV309-1	W-I	1219-00-0111	1.000
Q201	TRANS QA053-060	2N5306	G-E	4901-05-3060	1.000
Q202	TRANS QB000-025	MJE803	MOT	4902-00-8030	1.000

WAVETEK PARTS LIST	TITLE HV PWR SPLY,HV309-1	ASSEMBLY NO. 1115-00-0006 PAGE: 1	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q203	TRANS QB000-023	MJE242	MOT	4902-00-2420	1.000
R201	RES,C,1/2W,5%,12	CF1/2-12	ASE	4700-25-1209	1.000
R202	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	1.000
R203	RES,WW,5W,5%,100	243E1015	SPR	4702-35-1000	1.000
R204	RES,C,1/4W,5%,220	CF1/4-220	ASE	4700-15-2200	1.000
R205	RES,C,1/4W,5%,3.9K	CF1/43.9K	ASE	4700-15-3901	1.000
T201	XFMR,HV,TT002-028	TT002-028	TR-UT	5610-00-0022	1.000

WAVETEK PARTS LIST	TITLE HV PWR SPLY,HV309-1	ASSEMBLY NO. 1115-00-0006 PAGE: 2	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	CONTACT MC000-068	08-50-0107	MOL	2113-07-0001	5.000
J201	CONN,6-PIN,KONEKTON MC000-076	09-50-3061	MOL	2113-06-0002	1.000

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	HARNESS,HV309-1	1219-00-0111 PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	CRT SKT,MC000-061	JCK2300	IEH	2112-00-0014	1.000
2	STRIP,TERMINAL HT108-001	847	HNS	2112-17-0002	1.000
C301 C302	CAP,ELEC,50V,9500UF	86F168/L	G-E	1510-21-0952	2.000
L301	YOKE,DEF LY000-001	EX2464	PTN	1812-00-0000	1.000
Q13	TRANS QB000-024	MJE703	MOT	4902-00-7030	1.000
Q14	TRANS QB000-025	MJE803	MOT	4902-00-8030	1.000
Q301	TRANS QB000-030	TIP36C	T-I	4902-00-0360	1.000
Q302	TRANS QB000-029	TIP35C	T-I	4902-00-0350	1.000
R301	RES,WW,50W,10 RM105-010	TYPE 0400B	OHM	4707-85-1009	1.000
T301	XFMR,PWR,TT000-026	TT000-026	W-I	5610-00-0010	1.000
V301	TUBE,CRT VV001-004	387-M12P1S	C-E	5710-00-0002	1.000

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	CHASSIS ASSY	1111-00-0011 PAGE: 1	H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	CONTACT MC000-068	08-50-0107	MOL	2113-07-0001	12.000
J403	CONN,15-PIN,KONEKTON MC000-081	09-50-3151	MOL	2113-06-0003	1.000

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	HARNESS ASSY	1219-00-0265 PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C401	CAP,MYLR,200V,.22UF	WMF2P22	C-D	1510-60-0224	1.000
CR401	LED,RED,T-1-3/4	NSL5046	NAT	4810-02-0001	1.000
J401 J402	CONN,BNC-F,50,PANEL UG-625/U	31-236	APL	2110-01-1011	2.000
R401	POT,10K,RP135-310	TYPE K-1-45	CTS	4610-30-6103	1.000
R402	POT,1M, PER B/P RP134-510	RP134-510	CTS-E	4610-30-2105	1.000
R403 R404	POT,10KRP102-310	RP102-310	W-I	4610-12-3103	2.000
S401	SWITCH,TOGGLE ST000-009	7561K4	C-H	5106-00-0007	1.000
S402 S403	SWITCH,P/O POT ASSY	SWITCH	W-I	5199-00-9999	2.000
ZA01	VERT PRE-AMP ASSY	1601C-PREAMP	W-I	1219-00-0024	1.000

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	FRONT PANEL ASSY	1118-00-0008 PAGE: 1	C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	FUSE CARRIER, 3AG	031.1666	PCC	2410-05-0009	1.000
2	FUSEHOLDER,BODY WITH MTNG.NUT	031.1653	PCC	2410-05-0010	1.000
C501	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	1.000
F501	FUSE,S.B.,2AMP MF000-002	MDX-2	BUS	2410-05-0001	1.000
J501 J502	CONN,BNC-F,50,PANEL UG-625/U	31-236	APL	2110-01-1011	2.000
R501	POT,50KRP124-350	WA26032S503UA	A-B	4610-10-8503	1.000
R502	POT,20KRP124-320	WA26032S-203MA	A-B	4610-10-7203	1.000
S501 S502	SWITCH,SPDTST000-003	MST-105D	ALC	5106-00-0002	2.000
S503	SWITCH,DPDT,LOCKING SS000-003	46256LFE	S-I	5105-00-0003	1.000

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	REAR PANEL ASSY	1118-00-0009 PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION ><	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C601	CAP,FILM,80V,.01UF	192P1039R8	SPR	1510-60-3103	1.000
C602	CAP,MICA,500V,.001UF	DM15-102J	ARC	1510-50-0102	1.000
C603	CAP,DISC,1KV,100PF	10TCU-T10	SPR	1510-10-3101	1.000
C604	CAP,DISC,1KV,10PF	10TCC-Q10	SPR	1510-10-0100	1.000
C606	CAP,DISC,1KV,20PF	60C0G200J	MDC	1510-10-0200	1.000
C608	CAP,MYLR,200V,.22UF	WMF2P22	C-D	1510-60-0224	1.000
C609 C611 C613	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	3.000
C612 C614	CAP,ELEC,10V,150UF	503D157G010CB	SPR	1510-20-8151	2.000
CR601 CR602	DIODE,SIGNAL	1N914	G-E	4807-01-0914	2.000
CR603 CR604	DIODE,ZENER,6.2V	1N4735	MOT	4801-01-4735	2.000
IC601 IC602	DUAL OP AMP	TL082CP	T-I	7000-00-8200	2.000
R601	RES,MF,1/8W,1%,1K	RN55D-1K	MILSP	4701-03-1001	1.000
R602	RES,MF,1/8W,1%,9.09K	MF55K-9.09K	ASE	4701-03-9091	1.000
R603	RES,MF,1/8W,1%,90.9K	MF55K-90.9K	ASE	4701-03-9092	1.000
R604	RES,MF,1/8W,1%,909K	MF55K-909K	ASE	4701-03-9093	1.000

WAVETEK PARTS LIST	TITLE VERT PRE-AMP ASSY	ASSEMBLY NO. 1219-00-0024 PAGE: 1	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION ><	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R606 R621 R622	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	3.000
R607	RES,C,1/4W,5%,56K	CF1/4-56K	ASE	4700-15-5602	1.000
R608 R609 R610	RES,C,1/4W,5%,2K	CF1/4-2K	ASE	4700-15-2001	3.000
R612	RES,MF,1/8W,1%,374K	MF55K374K	ASE	4701-03-3743	1.000
R615	RES,P/O SWITCH ASSY	SWITCH-P	W-I	4799-99-9998	1.000
R616	RES,C,1/4W,5%,680	CF1/4-680	ASE	4700-15-6800	1.000
R617	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	1.000
R618	POT,250K,RP131-425	360T254B	CTS	4610-00-3254	1.000
R619	RES,C,1/4W,5%,3.9K	CF1/43.9K	ASE	4700-15-3901	1.000
R623*	RES,VAL DET IN CALIB	RES,TRIM	W-I	4799-99-9999	1.000
S601	SWITCH,P/O SW ASSY	SWITCH-S	W-I	5199-00-9998	1.000
S602	SWITCH,ASSY,ROTARY SR000-027	C227-1-RK-T450	CTS	5104-00-0014	1.000

WAVETEK PARTS LIST	TITLE VERT PRE-AMP ASSY	ASSEMBLY NO. 1219-00-0024 PAGE: 2	REV B

SECTION 7
SCHEMATICS

7.1 INTRODUCTION

This section contains all schematics for the instrument. A schematic index is given in Section 7.3.

7.2 SCHEMATIC NOTES

The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

Unless otherwise noted, resistor values are given in ohms, capacitor values are given in pF, and inductor values are given in μH.

SYMBOL NOTES

Denotes DC voltage reading unless otherwise specified.

Denotes high-impedance crystal detector reading in volts unless otherwise specified.

Denotes 50 ohm crystal detector reading in volts unless otherwise specified.

Signal or voltage source.

Connects to indicated signal or voltage source.

Arrow indicates clockwise rotation of wiper.

Coaxial jack

Coaxial plug

Coaxial cable

Factory adjusted part.

Denotes a front-panel device.

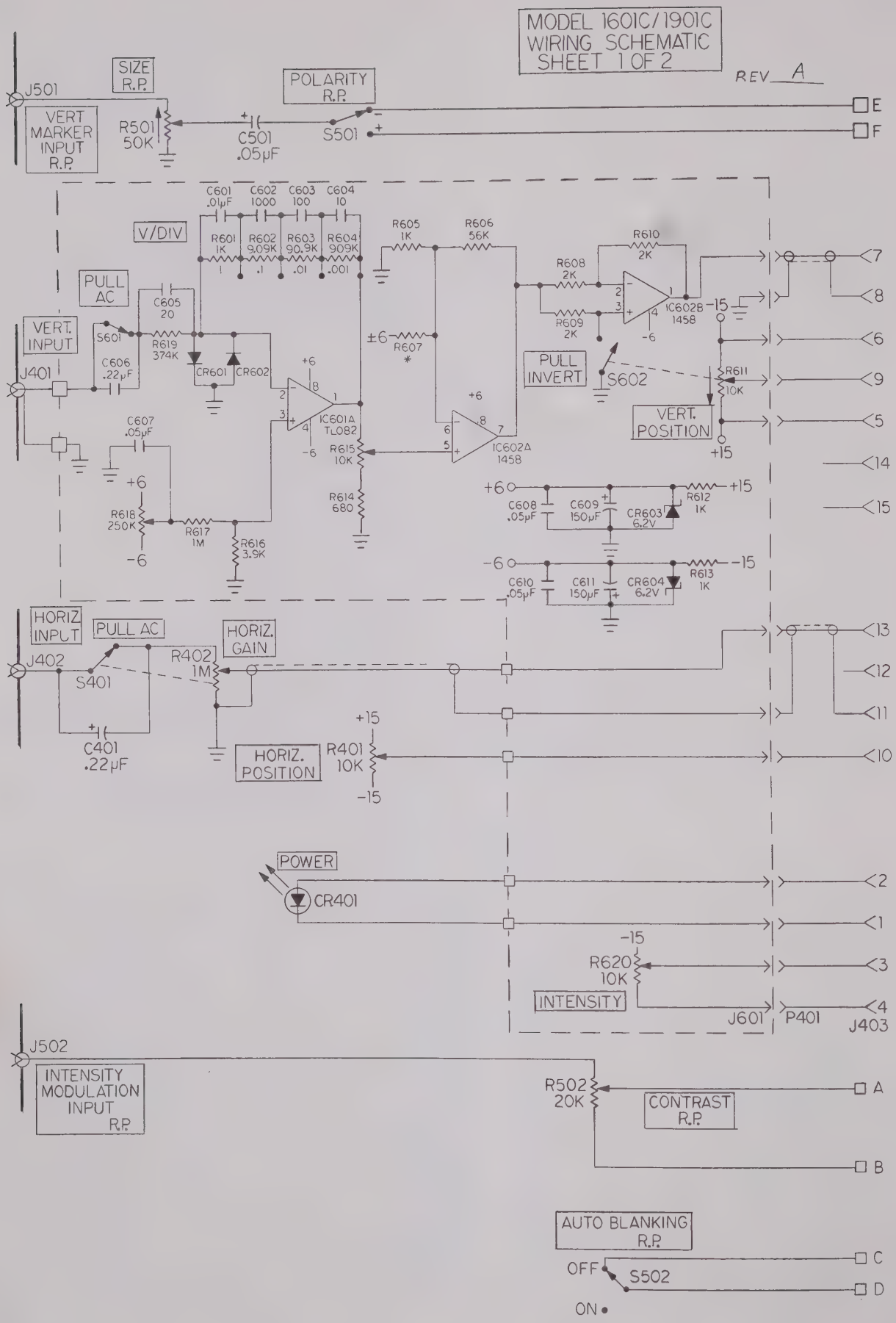
Denotes a rear-panel device.

Denotes a printed circuit board adjustment or accessible module adjustment.

Denotes an internal module adjustment not accessible without removing module cover.

ABBREVIATION CODE

A	ampere
AC	alternating current
C	capacitor
ccw	counterclockwise
CR	diode
CW	continuous wave
cw	clockwise
dB	decibel
dBc	dB referred to carrier
dBm	dB referred to 1 mW
dBmV	dB referred to 1 mV
DC	direct current
DS	indicating device, lamp
F	farad
F.P.	front panel
H	henry
Hz	hertz
IC	integrated circuit
IF	intermediate frequency
J	jack
K	relay
kHz	kilohertz
kΩ	kilohm
kV	kilovolt
kW	kilowatt
L	inductor
M	meter
MHz	megahertz
MΩ	megohm
mA	milliampere
mH	millihenry
mV	millivolt
mW	milliwatt
μF	microfarad
μA	microampere
μH	microhenry
Ω	ohm
OC	opto-coupler
P	plug
p	peak
pp	peak-to-peak
pF	picofarad
Q	transistor
R	resistor
RF	radio frequency
RMS	root-mean-square
R.P.	rear panel
S	switch
T	transformer
T.P.	test point
V	volt
VA	voltampere
W	watt
X	crystal


MODEL 1601C/1901C
WIRING SCHEMATIC
SHEET 1 OF 2
REV A
J501
SIZE R.P.
VERT MARKER INPUT R.P.
R501 50K
C501 .05μF
POLARITY R.P.
S501
E
F
V/DIV
C601 .01μF
C602 1000
C603 100
C604 10
R601 1K
R602 9.09K
R603 90.9K
R604 909K
R605 1K
R606 56K
R607 *
R608 2K
R609 2K
R610 2K
IC602B 1458
PULL AC
C605 20
VERT. INPUT
J401
S601
R619 374K
C606 .22μF
CR601
CR602
IC601A TL082
R615 10K
R614 680
IC602A 1458
PULL INVERT
S602
R611 10K
VERT. POSITION
C607 .05μF
R618 250K
R617 1M
R616 3.9K
C608 .05μF
C609 150μF
CR603 6.2V
R612 1K
C610 .05μF
C611 150μF
CR604 6.2V
R613 1K
HORIZ INPUT
PULL AC
J402
S401
C401 .22μF
HORIZ. GAIN
R402 1M
HORIZ. POSITION
R401 10K
POWER
CR401
R620 10K
INTENSITY
J601
P401
J403
J502
INTENSITY MODULATION INPUT R.P.
R502 20K
CONTRAST R.P.
A
B
AUTO BLANKING R.P.
OFF
S502
ON
C
D
1
2
3
4
5
6
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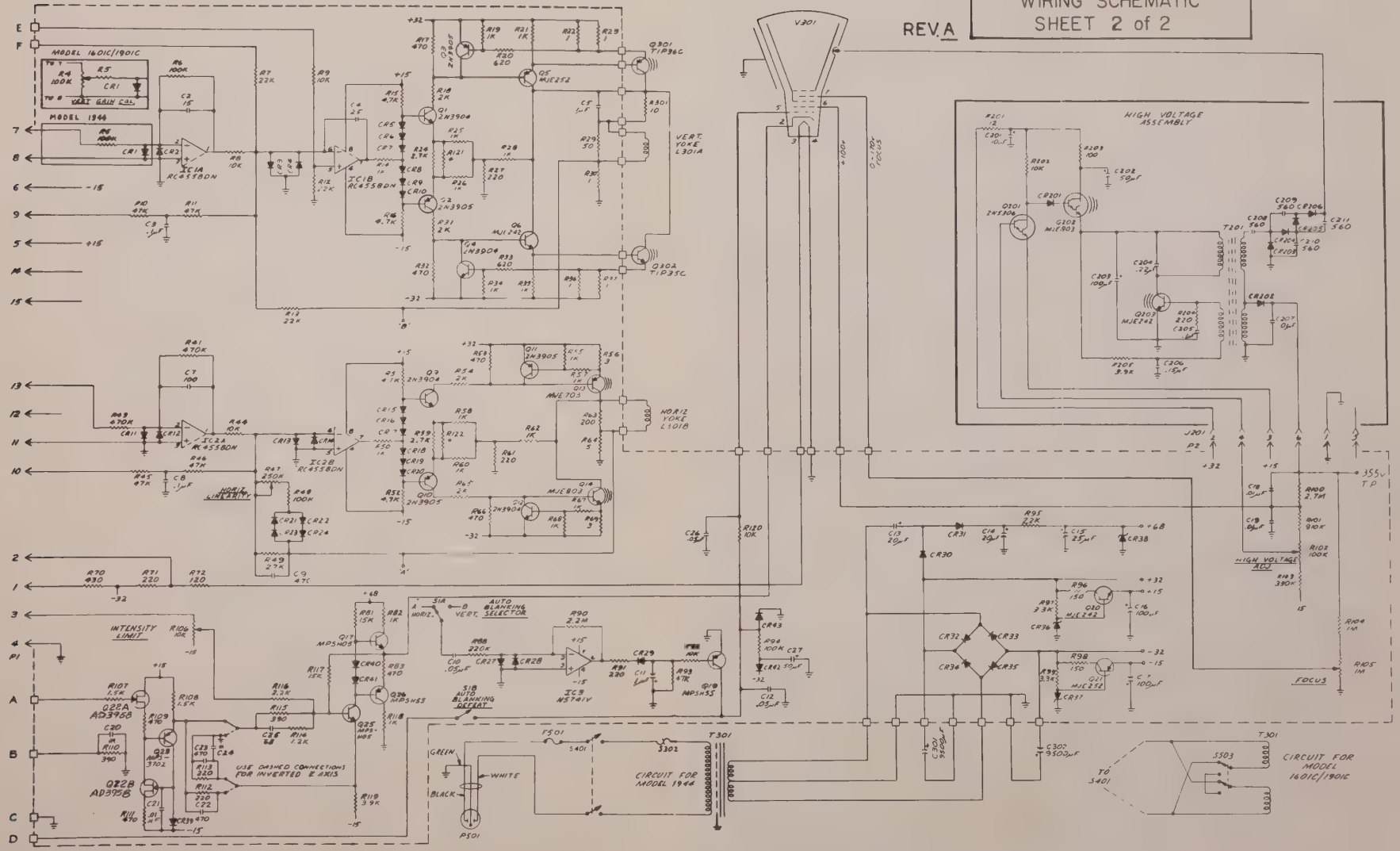
15

MODELS 1601C/1901C/1944
WIRING SCHEMATIC
SHEET 2 of 2

REV. A



MANUAL CHANGES

WAVETEK'S product improvement program incorporates the latest electronic developments into these instruments as rapidly as development and testing permit. Due to the time required to document and print these instruction manuals, it is not always possible to include the change information in the current printing. The following changes should be made to this manual:

Due to vendor changes, the wire connecting the CRT cathode and TP7 may be either a gray wire or a yellow wire. If a gray wire is used, no yellow wire will be present. If a yellow wire is used, no gray wire will be present.

On the CRT itself, pins 1 and 5 are internally connected together, and either may be used to connect the CRT grid to the blanking circuit.

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